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Protection of Foreign Exhibitors

For the purpose of inducing foreign manufacturers to exhibit their products at the Panama-Pacific International Exposition at San Francisco in 1915, Congress has passed a law, known as the Kahn act, which provides that articles imported shall be admitted free of duty for exhibition purposes, although not for sale. This provision seems excellent and will doubtless meet with universal approval. Considerable dissatisfaction has arisen over another section of the same bill which provides that it shall be unlawful for any person, without authority of the proprietors, to copy within three years any exhibited article protected by the laws of any foreign country. It is asserted in some quarters that the effect of the law will be to vest all foreign governments with the right to grant all kinds of protection within the United States and make our own citizens liable to penalties for infringing alleged rights under the laws of any foreign government. There can be no doubt that this effect was not intended by the framers of the law, and it is earnestly to be hoped that the law will either be amended or interpreted by the courts in accordance with the well-understood intentions of its framers.

Employees' Scholarships

The employee who seeks to improve himself by education and training is worth encouraging in every legitimate way. By increasing his own value he not only augments his immediate usefulness to the company but he makes himself moreover a marked man, bound to rise in any organization of which he is a part. Recognizing this ambitious spirit, many far-sighted business houses are offering liberal facilities and encouragement to employees who desire to undertake, in their own time, class-room studies of value in connection with their daily work. Some have even gone to the extent of defraying tuition expenses outright in order to stimulate workers' interest. One of the most practical of these philanthropies, and one which has the advantage of letting the student earn his scholarship by his own industry, is that offered to the staff of the Brooklyn Edison company. Any employee of that company may take up work in any local school or college approved by the scholarship committee, and his tuition, if due in advance, will be paid by the company, which then deducts in instalments the amount from his salary. If at the end of the course the student has passed his examinations with a grade of 66 per cent or better, the company returns the amount deducted, so that the industrious scholar receives his schooling without cost. Women as well as men are entitled to share in the plan. The policy is a generous one, but in its wisdom and its power to stimulate lies its distinction, for it makes the employee not a ward of corporate philanthropy but a prize-winning student who purchases knowledge with the scholar's coin of industry.

Magnetic Testing and Elastic Strain

The measurement of the magnetic properties of iron, steel and other magnetic materials is beset with many minor difficulties, and, like the testing of rubber, is appreciably influenced by technique. An instance in point has recently been given in a paper by Messrs. A. Campbell and H. C. Booth, read before the Physical Society of Great Britain and recently abstracted in *The Electrician*. It is shown that the mere bending of a strip of steel into a closed hoop or ring, with the attendant mechanical stresses imposed on the substance of the strip, involves very considerable changes in the magnetizing field required to elicit flux densities between 5 and 10 kilogausses. In all of the cases reported the impressed field has to be increased, in order to elicit as much flux density under temporary stress as in the unstressed state. In some cases with weak fields the impressed field had to be doubled. Clearly samples of magnetic metal tested either for permeability or for hysteretic loss should be as free as possible from mechanical stresses. In fact, it may be considered that the well-known magnetic benefits derived from annealing iron are due to the consequent elimination of internal molor or molecular stresses. It is not surprising, therefore, that the permeability of the specimens tested by Messrs. Campbell and Booth diminished under temporarily impressed stress, but it is surprising that the diminutions in permeability thus observed were so great.

Some Features of Station Design

The account of the new turbo-generator station in Louisville published elsewhere in our columns brings out some interesting details. In a general way the steam-driven generating station of the present day is more or less a cut-and-dried affair. The present development of standard turbo-generators is one which uniformly leads to satisfactory results, and in comparing station with station the most conspicuous and by far the most interesting differences are usually to be sought in the equipment outside of the generating room. The Waterside station at Louisville is a case in point. Generally well designed and equipped with first-class electrical apparatus, its situation gave opportunity for some unusual features in other particulars. Most noticeable of these is the deep pit for containing the condensers, a pit located 53 ft. below the turbine-room floor in order to insure full efficiency at all stages of the Ohio River, which is only too well known as a very variable

stream. The intake tunnels for condensing water are likewise unusual, with their duplicate lines of concrete pipe connecting to the cast-iron pipe with flexible joints leading out to concrete cribs in the river. No chances were taken with these intakes, since they are located low enough to be of service even if the government dam, which ordinarily steadies the flow at Louisville, should be carried away. Another good point in the station is the very complete coal-handling equipment, including even a crusher in case run-of-mine coal should later be used, and with full opportunity for unloading river barges whenever it is found desirable to install the necessary equipment. Similarly, the ash disposal conveyer system is thoroughly worked out, a very important matter for a plant using, as does this one at present, rather low-grade coal. It is altogether likely that the secret of economy in steam production in the future will lie in the efficient use of the cheaper grades of coal, and an equipment which permits and facilitates such use is a valuable asset for the future. Another unusual feature of the equipment is a load indicator of very simple character, serving to signal the fire room when more steam is likely soon to be needed. The signal system is not merely automatic but also enables the operator, foreseeing the trend of the load, to send word ahead of time to the boiler room. The station throughout is built with an eye to the future, both with respect to increased output and to variations in the distributing voltage which will follow along with increasing load. The electrical design details are thoroughly worked out, and the whole station is an excellent example of the good results following a merger of isolated companies and the physical union of the systems involved.

Monopoly and Rate Discrimination

Apparently the Uniform Electric Rate Association has been formed for the purpose of leveling all rates for electric energy to a common figure. Its propaganda is designed to prevent the establishment of such rates from central stations as will compete with existing isolated plants and will prevent the installation of new isolated plants. It is supported by an opinion of Mr. Louis D. Brandeis in which certain questions founded on a declared "statement of facts" are answered. Although the "statement of facts" and the opinion are somewhat confusing in their interpretation of well-known conditions in the electrical industry, there is enough apparent show of reasonableness about the situation which they picture to require discussion. The array of "facts" begins with the assertion that there is a general movement to secure for some electric service company in each city a substantial monopoly of the electric business in that city. This is amplified by the statement that "in order to secure business adequate to feed central stations equipped with steam turbines, it is ordinarily deemed necessary to suppress competing supplies of electricity."

No one will deny that conditions are tending toward monopoly of each form of public-utility service in every city. This is the tendency, not because the public-service utility may by this means suppress competition, but because it is economically more practicable for one agency to supply a community than for a number to do so. Where one agency has a monopoly it can make its costs of production and transmission less than the combined costs of two or more competing agencies and there is a resulting advantage to consumers. If the small plant serving a single building within a community gradually expands its activities it may become in time a utility furnishing a service that duplicates in part that of the company occupying the larger area of the city. It is for this reason that small plants selling any energy are placed within the reach of the public-utility commission laws. The commissions recognize that it is economically disadvantageous for a city to have two competing utilities of one class, because experience shows that eventually their duplicating facilities are always merged with resultant duplication of capital investment on which the public is asked to pay a return. Where the service and rates of an existing utility are satisfactory the commissions promote monopoly of the kind which Mr. Brandeis criticises by refusing to grant permits to new companies seeking to compete. By their adherence to this policy they serve the public interest.

The "statement" on which Mr. Brandeis bases his opinion deals with the cost of the service and apparently leaves out of consideration the value of the service. It is so worded as to create the impression that the real issue involved lies between the large and the small consumer. In other words, the question of whether the public-service corporations are discriminating in favor of the large user as against the small is the final legal problem to be solved. Approached from this angle the declaration of the attorney is that the precise questions "have not been authoritatively decided in the United States, but the principles which must govern are definitely established." Perhaps he is not informed that they have been authoritatively decided by commissions vested with broad powers. The language of his opinion is in effect that if the costs for large and small users of energy are the same, all things being taken into consideration, no legal justification exists for discriminating between them. This is obscure and it fails to support the argument underlying the movement. Mere differences in rates are not discriminatory. As we understand the spirit of the public-service commission laws and the public temper of the times they demand like rates under like conditions of service. With this demand we are in full accord, and if the companies have not made their rates conform to this principle they should do so as soon as possible. However, we believe that the value of the service is a necessary factor in rate-making in any scheme of variable rates. But even if an indefinite factor of this nature is designated as something other than "value" of the service, it is clear that wholly reasonable grounds exist for variable rates.

Mr. Brandeis has had enough experience in the study of conditions on steam railroads to enable him to appreciate the fact that the same kind of "discrimination" which he discusses so suavely in electrical plants exists also in those great public-utility corporations. If the wholesale user of steam railroad service within the commutation zone did not get a lower rate than the retail user of a single ride, he could not afford to live in the country. The whole-

sale user of mileage books also gets a lower rate than the retail single rider. Similarly, the opinion states that the "great weight of authority as well as of reason seems opposed to permitting any discrimination based upon the use to which the electric energy is put; and therefore upon the facts assumed in the question such discrimination between charges for electric energy used for power and charges for electric energy used for light should be held illegal." Yet when we refer again to the railroad rate structure, which in the essentials now under consideration has stood the tests of time, the courts and public opinion, we find that the railroad has a very keen financial concern in the use to which a freight car is put. Will it be used for the transportation of silk? Or is coal the commodity to be transported? It seems to us that there is here a perfect analogy to the question regarding the use of energy for lighting or industrial service, and that in both cases the value of the service or some factor not resting wholly upon a uniform cost must be taken into consideration. When all of the facts are marshaled the controlling one appears to be that the production of energy on a large scale, with resultant cheapening of costs, is part of the economic march of progress. However much sympathy we feel for those whose plants become obsolescent because of improvement in the art, the greatest good of the greatest number should be the dominating consideration; and this demands, and will not be denied, those conditions which produce most successfully the needed economy and perfection of service.

The Absorption of Energy in the Eye

Perhaps no subject in physiological optics has been more misunderstood and less thoroughly studied than the actual effect of radiation received by the eye. A great deal of labor, in no small degree useless, has been expended on the subject without reaching conclusions of final value. The weak point of investigation has nearly always been the utter absence of any quantitative data. An experimenter finds that some kind of energy, heat energy, strictly luminous energy or ultra-violet energy, does or does not produce certain effects on the eye and immediately proclaims the fact entirely regardless of the actual quantity of energy responsible for the result or lack of it. One can count on the fingers of one hand all the researches which are upon a quantitative basis, and therefore every addition to this list is a matter of interest and probable value. In an article in this issue Mr. M. Luckiesh takes up the much-neglected question of the possible effect on the eye of the absorption of energy, chiefly other than luminous. With most artificial illuminants, at least those giving continuous spectra, by far the greater part of the radiation is in the infra-red invisible portion of the spectrum. Hence the possible effect of infra-red radiation and its absorption by the media of the eye may have importance.

An often-quoted statement of Dr. C. P. Steinmetz as to the importance of energy effect of this sort has served to direct attention to the subject, although as a matter of fact there is not one bit of practical experimental evidence one way or the other connecting this energy effect with eye strain or irritation. To tell the honest truth, the cause of the ordinary eye strain in poor natural or artificial illumination is very far from being really understood. Nevertheless, Dr. Steinmetz's suggestion is worth attention, and the actual absorption of radiant energy by the media of the eye is a very desirable thing to know. This Mr. Luckiesh has given us in a measure of the absorption of the media, considered as water, for the total radiation received from radiators at different temperatures. The chief seat of absorption is shown to be in the cornea, this being the first layer encountered and consequently in obedience to the general laws of absorption producing the maximum effect. Not only does the cornea absorb a large amount of the incident energy in general, but it also has a strongly selective absorption for the extreme ultra-violet, cutting off entirely rays below 300 $\mu\mu$ in wave length. Most of the remaining ultra-violet is cut off by the lens, but the whole ultra-violet factor in the luminous sources considered by Mr. Luckiesh is practically rather small. The radiation is absorbed largely by the cornea, but this superficial layer, of course, is cooled with exceptional readiness, so that in a degree it is self-protected. If the whole effect of radiation on the eye were expressible in terms of this absorption by the media, one could very readily figure out in any given case the actual incidence of energy in ergs per second per square cm and get a very satisfactory measure of the amount of energy effect with which one has to deal.

Recent investigations have shown it to be highly probable that the general energy radiation, rather than any specific kind of radiation, is responsible for some ocular troubles which have been noticed, especially glass blower's cataract, in an earlier state of knowledge ascribed to ultra-violet radiation. Mr. Luckiesh's figures, however, show that the total amount of energy received from this particular source in bodies, like molten glass, at rather low temperature must be very small and that the cornea cuts off a large proportion even of the heat radiation.

The two points which Mr. Luckiesh's investigation does not throw light upon, and which may be justification for Dr. Steinmetz's statement, are that the concentration of energy, owing to the refraction of the media, increases very rapidly from the front to the back of the eye. Perhaps three-quarters of the total refraction is at the surface of the cornea, so that there is some concentration at the front of the lens, more still at its back, and most of all on the retina, where the pigmentation insures the absorption of practically all radiation that reaches it. Hence there may be discomfort or even damage, as in eclipse blindness, produced under strong general radiation even in spite of the large absorption of the superficial layers. Incidentally it should be mentioned that in dealing with solar radiation at an equivalent temperature of about 6000 deg. the point of maximum intensity is no longer in the infra-red or in the part of the spectrum vulgarly supposed to be the seat of heat radiation, but in the region of the blue, so that for this particular source any distinction between visible radiation in general and heat radiation becomes utterly lacking in significance. Mr. Luckiesh has done well in putting before us in clear quantitative form the fundamental facts as to the absorption of the media of the eye.

The News of the Week

Activities and Events in the Electrical Field—Reports of Meetings—Commission Findings, Etc.

Government Investigation of All Public Utilities

According to a statement made by Secretary Redfield of the Department of Commerce Oct. 22 in a speech before the Flint (Mich.) Board of Commerce, his department proposes to begin an investigation of public utility corporations. The inquiry will be made by the Bureau of Standards and will be conducted in a spirit of entire friendliness and with the object of aiding both the corporations and the public service commissions of the various states and cities. Congress is to be asked for an appropriation of $100,000 to enable the Bureau of Standards to carry on such investigations as would fix standards of service for public utility companies and thus assist public service commissioners and other authorities in the regulation and control of these utilities.

The Uniform Electric Rate Association

An announcement stating that the first annual meeting of the Uniform Electric Rate Association, promoted by manufacturers of apparatus for isolated plants, would be held on Oct. 20 was published in the *Electrical World* for Oct. 4, 1913. Numerous efforts to obtain information regarding the place of the meeting made at the office of the secretary, Room 1107, 114 Liberty Street, New York, proved unsuccessful, and all information concerning the proceedings and the personnel of the officials has been withheld. At the office of the secretary it was stated that instructions had been received to make no public statements concerning the matter, and information was courteously declined on all points, although it was admitted that the meeting was held on the date set.

Joint Rubber-Insulation Committee Report

At a meeting on Oct. 15, 1913, of the committee on rubber insulation appointed by manufacturers and users of this material in December, 1911, under the chairmanship of Major S. Reber, of the United States Signal Corps, a preliminary report of work accomplished during the past two years, leading to a specification for 30 per cent Para compound and an analytical procedure to be put in use for one year, was presented and adopted. The committee was authorized to make arrangements for the publication of the report, which has already been incorporated in committee reports of the American Electric Railway Association and the Association of Railway Electrical Engineers.

It is the intention of the joint rubber-insulation committee to urge the acceptance of the report by other national societies to the end that the manufacturers shall have to work to only one specification for 30 per cent Para compounds, a result that would bring considerable economies to the manufacturers and corresponding gain to the consumers. The meeting which resulted in the formation of this committee was held upon the invitation of Mr. E. B. Katté, of the New York Central Railroad, and was participated in by representatives of the United States Signal Corps, the United States Bureau of Standards, the American Chemical Society, the New York Central lines, the Pennsylvania Railroad, the General Electric Company, the Hazard Manufacturing Company, the Lederle Laboratories, the Simplex Wire & Cable Company and the Standard Underground Cable Company.

Prospects for the 1915 Electrical Congress

History shows that the world's trade was profoundly affected by the cutting of the Suez Canal and the consequent supersession of the maritime highway round the Cape of Good Hope. The short-circuiting of that old route greatly reduced the commercial impedance of the Eastern Hemisphere. It is therefore only reasonable to expect that the opening of the Panama Canal will exercise a yet greater effect upon the trade of the Western Hemisphere. The short circuit of the Horn is more significant than the short circuit of the Hope; because the maritime route of the former runs to 53 deg. of south latitude, whereas that of the latter runs only to 35 deg. Moreover, the Suez Canal lies across a flat sheet of desert, only a few meters above ocean, whereas at Culebra the Panama Canal cuts through the vertebral column of the great American mountain chain. From every point of view, there can be no doubt that the opening of the American canal at Panama will constitute one of the great events of history and should therefore be attended with commensurate observances.

From the electrical engineering standpoint, the occasion is to be commemorated by an international electrical congress at San Francisco, in conjunction with a meeting of the International Electrotechnical Commission, under the auspices of the American Institute of Electrical Engineers, and during the period of the universal exposition at San Francisco. The electrical congress is to be held during the week beginning Sept. 13, 1915, and immediately preceding the general engineering congress of Sept. 20 to 25. The general engineering congress is supported by the American Societies of Civil Engineers, of Mining Engineers, of Mechanical Engineers and of Electrical Engineers; but the American Institute of Electrical Engineers has undertaken only a minor share in this support, because the Institute stated that the international electrical congress would receive its especial consideration, more or less to the exclusion of the general engineers' congress, which, being fostered by several other national engineering societies, would have ample consideration.

Preparation for the international electrical congress of San Francisco has been kept in view by the two last presidential administrations of the A. I. E. E., and particular attention is now being given to it by President Mailloux. Dr. C. P. Steinmetz has already consented to serve as the honorary president of the congress, and Dr. E. B. Rosa as the honorary secretary. Mr. H. G. Stott is chairman of the committee of organization, and Mr. Preston S. Millar is the secretary-treasurer.

Twelve sections of the congress have been provisionally arranged for, and a number of papers have already been promised by electrical engineers of world-wide reputation. It is expected that the organization committee will shortly set systematic plans in operation both for enlisting members and for securing a good list of papers from all parts of the world. An international congress differs essentially from a national congress in the fact that the membership, attend-

ance, proceedings and publications must to a great extent be international and be participated in by countries other than that in which the congress is held. The chairmanship of the organization sub-committee on foreign relations is fortunately held by Mr. Mailloux. We hope to be able to furnish our readers with particulars concerning the program and plans of the congress as these are settled by the organization committee and are made known to the technical press.

Electrical Co-operation

In an address before the Jovian Congress in New York on Sept. 16 Mr. James H. Collins stated that "co-operative effort in the electrical industry will probably save this country from what many regard as the fallacy of state ownership of utilities. Where the central station, the jobber, the contractor and the manufacturer work at cross purposes, or even without a mutual understanding as to what they want to accomplish, public sentiment is likely to grow toward public ownership. Much is said and written about its advantages every day by people who either overlook the truth or are not hampered by the facts, and the public accepts glittering generalities without knowing the exact details.

"This is a very serious issue, undoubtedly, to be met in the near future. It can be met best on a basis of co-operation among electrical men. It will not be settled by any influence that can be brought to bear on legislation, or the press, or anywhere else. But when the electrical men in each community, instead of fighting for ready-made business competitively, get together to develop new business through the advancement of the community in the broadest possible way, then it will be clear to the public that the electrical interests are really public servants, even though ownership be in corporation form.

"There are other issues of the same sort—big, broad, growing issues that call for the kind of co-operative spirit that develops with co-operative action. It will be found that discounts will adjust themselves and be forgotten, and who is to sell lamps and appliances will be settled congenially, and then those interested will begin to build up the industry on such broad lines that the public will see it as a whole and trust it as an institution, whether the dealing is with the central station, or contractor, or manufacturer, or jobber. It will be clear that all these interests belong to the same thing, and that they are working toward the same big end, and that any transaction with one is a transaction with all."

Protection of Foreign Exhibits

A convention of manufacturers, merchants and importers will be held at the Hotel Astor, New York, on Nov. 21, 1913, at 2 p. m., to advocate the enactment of an American registration law to protect manufactured products of original design, to consider the recently enacted Kahn law, and to advocate amendments to eliminate the objectionable features of this law. This convention has been called by the officers of the National Registration League and a committee of the Federation of Trade Press Associations.

The Kahn law has just been passed by Congress for the protection of foreign exhibitors at the Panama-Pacific International Exhibition. In addition to admitting articles free of duty for exhibition purposes, it provides a penalty of imprisonment or fine of from $100 to $1,000 for copying, imitating, reproducing or republishing in three years any pattern, model, design, trade-mark, copyright or manufactured article protected by the laws of any foreign country.

The National Registration League, which has its headquarters at 1309 Race Street, Philadelphia, contends that under the provisions of this law it is not only possible but probable that many exhibits at the exposition will be the subject of foreign protection of some kind, notwithstanding that the same things have been free from all character of protection in this country for many years. The law will make effective within our country laws governing the grant of patents, trade-marks and registrations of every country on earth and will make our own citizens liable to the penalties of this bill for infringing alleged rights under the laws of any and all foreign governments.

The effect of the law, it is contended, will be to throw the patent and trade-mark situation into great confusion and to do untold injury to owners of American patents, trade-marks and design property, as well as to manufacturers of articles which any one is now free to make. It will also afford opportunity for unscrupulous persons to harass and blackmail reputable manufacturers and merchants in many ways.

Boiler Explosion in Staten Island Power Plant

The explosion of a 330-hp vertical water-tube boiler in the Livingston plant of the Richmond Light & Railroad Company, Staten Island, N. Y., Oct. 21, tore a 60-ft. hole in the roof of the boiler house and carried away a large section of the breeching, cutting off the remaining boilers from the stack. Although the force of the explosion killed six men and injured four others, the damage inflicted on the plant was not widespread, probably owing to the fact that the main force of the explosion seemed to be directed upward. As soon as the officials of the company learned of the disaster an old railway plant at Grasmere, a property of the company, was pressed into service to supply energy to the electric railways of the island. As this issue goes to press negotiations are under way with the Public Service Corporation of New Jersey and the Edison Illuminating Company of Brooklyn for the purchase of sufficient energy to carry the lighting load until operation is restored at the plant. Some delay has been caused in making these connections as it is necessary to obtain the consent of the War Department before a submarine cable can be laid across the Narrows to Brooklyn or across the Kill von Kull to the New Jersey stations.

Mr. S. F. Hazelrigg, vice-president and general manager of the company, stated that the repairs would probably occupy the greater part of three days as the twisted mass of débris must be entirely removed before the breeching can be replaced.

Meeting of Executive Committee of the Commercial Section, N. E. L. A.

The executive committee of the Commercial Section of the National Electric Light Association met at association headquarters in New York Oct. 16 in an all-day session at which fifteen out of the eighteen members of the committee were present. At this meeting it was determined to standardize the size of the "Electrical Salesman's Handbook," the revised edition of which will appear on Jan. 1, and the dimensions of which will be 4.5 in. by 9 in. As intimated in these columns some time ago, the publications committee, of which Mr. Douglass Burnett, of Baltimore, is chairman, is at present engaged in revising the Handbook and the work has been placed in the hands of the following sub-committees: Mr. C. J. Russell, Philadelphia, general data; Messrs. S. E. Doane, Cleveland, Norman Macbeth, New York, and G. H. Stickney, Harrison, N. J., lamps and illumination; Messrs G. H. Jones, Chicago, and C. H. Stevens, Brooklyn, power and heat, and Mr. M. S. Seelman, typography. The executive committee in its efforts to induce manufacturers of electrical apparatus to issue catalogs and data sheets on standard 4.5-in. by 9-in.

sheets has sent letters to eighty manufacturing companies, fifty of which have agreed to co-operate with the committee in the matter.

It was determined to issue the annual year book of the Commercial Section, which will contain all the names, addresses and affiliations of members of the section, on Jan. 1. The following committees were also appointed: Committee on the wiring of existing buildings, Mr. R. S. Hale, Boston, chairman, Mr. S. E. Doane, Cleveland, vice-chairman, and Messrs. C. E. Robertson, Baltimore, M. E. Turner, Cleveland, W. A. Donkin, Pittsburgh, W. P. Lyon, Chicago, G. Wiederman, Brooklyn, and M. C. Rypinsky, New York; committee on interurban lighting of highways, Mr. G. B. Tripp, Harrisburg, chairman, Mr. C. G. M. Thomas, Long Island City, vice-chairman, and Messrs. H. J. Gille, Seattle, C. N. Stannard, Denver, E. S. Marlow, Washington, P. S. Young, Newark, S. M. Kennedy, Los Angeles, W. H. Lott, Boston, R. S. Wallace, Peoria, and N. R. Birge, New York; committee on electrical merchandising and advertising, Mr. Parker Kemble, Cincinnati, chairman, Mr. L. D. Gibbs, Boston, vice-chairman, and Messrs. G. B. Johnson, Chicago, W. H. Hodge, Chicago, H. K. Mohr, Philadelphia, W. G. Stetson, Boston, M. O. Dell Plain, Syracuse, S. L. Nicholson, Pittsburgh, F. B. Rae, New York, W. Gould, New York, F. H. Gale, Schenectady, and a representative of the Canadian Electrical Association; committee on the education of salesmen, Mr. F. C. Henderscott, New York, chairman, F. R. Jenkins, Chicago, vice-chairman, and Messrs. R. N. Ballard, Los Angeles, J. A. Britton, San Francisco, C. A. Howlett, New York, A. Larney, Minneapolis, H. D. Shute, Pittsburgh, G. Webster, Conneaut, and F. S. Balyeat, Pittsburgh; committee on development of non-peak load, Mr. G. H. Jones, Chicago, chairman, J. C. Meyer, Philadelphia, vice-chairman, and Messrs. J. Parker, Rochester, A. C. Smith, Buffalo, R. H. Tillman, Baltimore, E. L. Crosby, Detroit, F. D. Beardslee, St. Louis, R. L. McClellan, Chicago, C. A. Greenidge, New York, and G. N. Tidd, New York.

It has been announced by Chairman T. I. Jones of the Commercial Section that the "Electrical Salesman's Handbook" and the data sheets to be issued from time to time will be distributed gratuitously to all members of the Commercial Section. The section has also recently brought out two booklets, one dealing with farm appliances and the other with church lighting.

The next meeting of the executive committee of the Commercial Section will be held at Nela Park, Cleveland, during the week of Dec. 8.

Boston Edison Welfare Work and Employees' Statistics

At the recent convention of the New England Section of the National Electric Light Association, held at Burlington, Vt., Mr. Herbert W. Moses, head of the Welfare Bureau of the Edison Electric Illuminating Company of Boston, Mass., outlined the results obtained during the first year of the latter's work. This bureau now has a superintendent, a librarian, a medical director, a chief clerk, an outside inspector and a stenographer. Its employment division was opened on Feb. 1 last, and up to July 1, 1566 applicants had been received. Medical examinations were given to 497, of whom 435 were accepted, the ratio of rejected applicants on this examination being about 10 per cent. Such preliminary scrutiny later saves the company from paying sick and death benefits.

An analysis of the payroll shows that 837 persons left the company's employment during the first year of the Welfare Bureau's work, and 1002 new employees were added to the organization. Of those who left the service 472 resigned and 365 were discharged. Mr. Moses outlined the scheme of sick and death benefits in force at Boston, which has previously been described in these columns. The company provides even more liberally for its staff than is required by the Massachusetts workmen's compensation act. During the year ended June 30, 1913, the company paid $4,201 in accident benefits, including two deaths. In five months it paid sick benefits to the amount of $2,534, and in nine months there were nine deaths, on which $2,917 in benefits was paid.

The company doctor saw 878 patients among the employees during the year and made 1343 calls, giving free medical attention in each case. Employees lost 1707 days on account of illness and in all there occurred 720 accidents on the system during the year, counting minor injuries. Of this number 450 were accidents to employees, two having been fatal. The remaining 270 accidents were suffered by the general public, nine being fatal. The latter class of accidents is largely attributable to the fact that the company has much of its construction work done by contract, for of these accidents all but ninety-three were incurred by the employees of sub-contractors. No time was taken from work in 343 of the accidents to employees, while in the remaining 105 cases 1387 days were lost. The maximum time lost was 187 days for one employee. Further study of the company's accidents shows that the maximum number occur between noon and 6 p. m.

On March 15 last the company started to lend funds to employees in certain cases in amounts up to a maximum of $100 without charging interest, a fund of $1,500 being set aside for this purpose. The total loans under this arrangement have been forty, aggregating $1,860, of which ten have been repaid in full, leaving thirty-four outstanding, aggregating $1,113. The work of the bureau for its first year has cost the company about $30,000, but the results contribute to increased efficiency and *esprit de corps*, and the company expects to expend about $50,000 in the work during the second year. Fewer and shorter absences and quicker recuperation in case of illness have been secured, and the standard of employees is constantly being raised.

Meeting of the American Physical Society

On Saturday, Oct. 18, a regular meeting of the American Physical Society was held at Fayerweather Hall, Columbia University, New York, with a morning and an afternoon session, at which the following papers were presented:

"The Vapor Pressure of Metallic Tungsten," by Dr. Irving Langmuir, General Electric Company, Schenectady; "The Form of the Ionization by Impact Function," by Prof. Bergen Davis, Columbia University; "Change of State Solid-Liquid at High Pressure," by Prof. P. W. Bridgman, Jefferson Physical Laboratory, Cambridge, Mass.; "Notes on Some Integrating Methods in Alternating-Current Testing," by Prof. Frederick Bedell, Cornell University; "Silvered Quartz Fibers of Low Resistance Obtained by Cathode Spray," by Prof. Horatio B. Williams, Columbia University; "The Critical Ranges A2 and A3 of Pure Iron," by Prof. G. K. Burgess and Mr. J. J. Crowe of the Bureau of Standards; "A Spectrophotometric Study of the Absorption, Fluorescence and Surface Color of Magnesium Platinum Cyanide," by Dr. Frances G. Wick, Vassar College; "Examination of the Omnicolored Screen Plate by Means of Microscope and Spectroscope," by Mr. John B. Taylor, General Electric Company, Schenectady; "Relativity Theory: General Dynamical Principles," by Prof. Richard C. Tolman, University of California; "The Hall Effect in Liquid and Solid Mercury," by Prof. W. N. Fenninger, Pratt Institute; "An Electrolytic Determination of the Ratio of Silver to Iodine and the Value of the Faraday," by Messrs. G. W. Vinal,

of the Bureau of Standards, and S. J. Bates, of the University of Illinois; "The Effect of Amalgamation on the Contact Emf of Metals," by Prof. F. J. Rogers, of Leland Stanford, Jr., University; "Relativity Theory: The Equipartition Law in a System of Particles," by Mr. Richard C. Tolman, University of California; "Failure of Color Photography by Commercial Screen-Plate Methods for Spectroscopic Records," by Mr. John B. Taylor, General Electric Company, Schenectady; "Condition Involving a Decrease of Primary Current with Increasing Secondary Current," by Prof. F. J. Rogers, Leland Stanford, Jr., University; "Some Experiments on the Magnetic Field of Two Electromagnets in Rotation," by Prof. S. J. Barnett, Ohio State University, and "The Effect of Space Charge and Residual Gases on the Thermionic Current in a High Vacuum," by Dr. Irving Langmuir, General Electric Company, Schenectady.

A regular meeting of the society will be held in Chicago on Nov. 29, and the annual meeting will take place at Atlanta, Ga., from Dec. 29, 1913, to Jan. 3, 1914. Prof. A. D. Cole, Ohio State University, Columbus, Ohio, is secretary of the society.

Chicago Section of Illuminating Engineering Society

At the meeting of the Chicago Section of the Illuminating Engineering Society held in the rooms of the Western Society of Engineers, Monadnock Block, Chicago, Oct. 15, Mr. J. R. Cravath gave a comprehensive review of the papers and discussions presented before the recent Pittsburgh convention of the society, reported in our issue of Oct. 4. His abstracts of the general sessions were followed by the presentation in full of two of the Pittsburgh convention papers which were the work of Chicago authors—"The Proper Lighting of Show Windows," by Mr. H. B. Wheeler, and "Factory Lighting," by Messrs. M. H. Flexner and A. O. Dicker. The papers were read by their authors and were illustrated with lantern slides.

As announced by Dr. M. G. Lloyd, chairman, future sessions of the Chicago Section will be opened with brief lectures on fundamental illuminating-engineering theory. New apparatus and illuminants will also be exhibited.

Telephone Pioneers Meet at Chicago

Fully 400 veterans of the telephone industry, all of whom were engaged in the business prior to the year 1890, attended the third annual convention of the Telephone Pioneers of America held at Chicago Oct. 17 and 18.

Among the men of prominence in the telephone field who made addresses during the sessions were Messrs. Theodore N. Vail, New York, who is president of the Pioneers' Association; Frank H. Bethell, New York, vice-president; Bernard E. Sunny, Chicago; Thomas D. Lockwood, Boston; N. C. Kingsbury, New York; Thomas B. Doolittle, New York, and Thomas A. Watson, Braintree, Mass. Mr. Kingsbury discussed some of the problems confronting the telephone industry, enumerating among these the development of apparatus for long-distance transmission, securing of capital for investment and methods of satisfying the public. Public-service commissions, he declared, furnish a safeguard against unjust rate regulation.

Following were the officers elected for the coming year: President, Mr. Theodore N. Vail, New York (re-elected); first vice-president, Mr. Thomas D. Lockwood, Boston; second vice-president, Mr. Thomas B. Doolittle, Branford, Conn.; third vice-president, Mr. C. F. Sise, Montreal, Que.; fourth vice-president, Mr. George E. McFarland, Montreal, Que.; secretary, Mr. H. W. Pope, New York (re-elected). Mr. Charles D. Dubois, of New York, was elected chairman of the executive committee.

On Friday evening at the Studebaker Theater the central group of Bell companies entertained the convention with a humorous skit based on the past and future of the telephone industry. On Saturday the delegates had luncheon at the Hawthorne Works of the Western Electric Company, returning to a banquet at the Congress Hotel in the evening.

Informality of Indiana Commission Proceedings

Mr. James L. Clark, a member of the Public Service Commission of Indiana, in a recent address before the Indianapolis Lawyers' Club, commented upon the lack of formality which the Indiana commission has decided shall mark its proceedings. He said the very purpose intended to be accomplished by the Indiana law requires the practice to be entirely void of technicalities.

"The public utility act regulating public service corporations has added another corner to the already large field for the lawyer," Commissioner Clark said. "Some have hastily concluded that it is a field for the specialist. To some extent that is true, but not to the extent that some have imagined. It will not require a specialist to construe the statute. Simplicity is one of the strong features of the law."

Pittsburgh Section, A. I. E. E.

A paper by Mr. H. O. Swoboda on the design, construction and operation of electric heating devices was presented before the Pittsburgh Section of the American Institute of Electrical Engineers Oct. 14, the meeting being the first to be held under the auspices of the newly elected officers of the section, of which Mr. A. M. Dudley is chairman and Mr. E. R. Spencer is secretary. The board of local directors also includes Messrs. F. Wiley, J. W. Welsh, W. O. Oschman, G. M. Eaton and M. C. Turpin.

Mr. Swoboda opened his address with a review of the history of electric heating and exhibited a number of devices using resistors of nickel, chromium, etc. During the last few years, said the speaker, the bare-wire heater has in Germany received competition from the "silundum" and "silit" heaters. These terms are trade names for rods and tubings of carbon treated with silicon vapor at high temperatures, the air being excluded. Such resistance materials are claimed to be practically indestructible if not used at temperatures higher than 1200 deg. C.

Insulated-wire heaters have been employed for such devices as heating pads. One method is to cover the resistor wire with an insulating material like enamel or asbestos. The wire can then be disposed without any attention to spacing, being wrapped around vessels, tanks, tubes, pipes, rods, etc., without further precaution. Another method is to embed the wire in enamel, cement, fire-clay, fire-sand, carborundum or other fireproof material. In this way sections of the wire are not only insulated from each other, but the air is excluded also. Heaters employing the induction principle were next shown and described. These avoid the use of special resistance wires, since by means of eddy currents induced in the material or vessel to be heated the heat is delivered directly where needed. Such devices are, of course, limited to use on alternating-current circuits.

Mr. Swoboda then passed to a discussion of resistance, induction and arc types of electric furnaces, describing the advantages and disadvantages of each.

Forty years ago the only resistor materials in existence were copper, platinum and German silver. With platinum out of the question on account of its costliness, it was then not feasible to construct a durable heater for use in the open air at a temperature higher than 250 deg. to 300 deg. C. When the copper-nickel alloys appeared on the market temperatures from 300 deg. to 500 deg. C. were made pos-

sible, and a little later the nickel-steel alloys raised the limit to 600 deg. Ten years ago the discovery of nickel-chromium alloys extended the maximum working temperatures up to 1200 deg. C. With the increase of working temperature the resistivity of the materials also increased, the specific resistance of nickel chromium being about three times that of German silver and sixty times that of copper. A well-designed heating device using nickel-chromium resistors will not burn out.

Mr. Swoboda made a strong plea for the standardization of contact plugs so that different makes of heating devices may use the same type of attachment plug. There are now about fifty manufacturers of heating appliances, each of whom has established his own standard plug. A similar condition formerly prevailed in Germany, but owing to the efforts of the national electrical engineering society five standard types of plugs have now been adopted. In closing, the author gave a number of interesting figures on the cost of operation of electrical devices compared with coal-heated and gas-heated apparatus, and declared his belief that the adoption of electrical heat for general use is bound to come ultimately.

Discussion of the paper was participated in by Chairman A. M. Dudley and Messrs. T. S. Perkins, W. L. Waters, E. E. Rose and M. C. Turpin.

Mr. Perkins divided heating apparatus into three classes —necessities, conveniences and luxuries. He declared that they have passed through the first stage and are now in the stage of conveniences and that people are beginning to recognize them as such. He also called attention to the small cost of electric cooking figured as a percentage of the value of the material under preparation. For instance, a 75-cent steak costs only 5 cents for cooking. The reverse is, however, true in the case of a cereal, which is costly to cook. The speaker predicted that the investment in heating apparatus will soon exceed that in incandescent lamps, which amounts to over $10,000,000.

Mr. Waters observed that while electric cooking is still in the class of luxuries, his own belief is that a range will soon be found which will be applicable to the use of the man of moderate means.

Mr. Turpin referred to the success of central stations in selling electrical appliances and cited the case of one whose peak comes on Tuesday morning owing to the town's electric-ironing load.

Proposed Sale of Toronto Utilities to the City

Owing to franchise stipulations which are considered restrictive by the city, the municipal authorities of Toronto, and particularly Mayor H. C. Hocken, are desirous of purchasing the street railways within the city limits. These railways are nearly all the property of the Toronto Railway Company, although portions of the lines of the Toronto & York Radial Railway Company and the Toronto Suburban Railway Company are within the city limits. Sir William MacKenzie is the president of the Toronto Railway Company, and he and his associates also own or control the Toronto Electric Light Company. The Mayor desired only to secure the street railways originally, but Sir William MacKenzie refused to sell the railway properties without the lighting property, so that the purchase of both is under consideration.

Mayor Hocken retained consulting engineers to make valuation reports on the two sets of properties. The report on street railways was made by Mr. Bion J. Arnold, of Chicago, and Mr. John W. Moyes, of Toronto, and was made public on Oct. 13. The report on the electric-light property was made by Mr. R. A. Ross, of Montreal. It fixed the total value of the property of the Toronto Electric Light Company at $6,132,754. The price asked is $8,000,000, which leaves $1,867,246 as the amount to be paid for the franchise and the business. The total amount asked for the street railways within the limits of Toronto is $22,242,405.73. However, the report of Messrs. Arnold and Moyes fixes the total value of the railways at $20,944,478. The difference in the case of the railways is caused by adding other items, such as estimated increment in the value of real estate during the eight years that the franchises have still to run.

The report of Messrs. Arnold and Moyes includes an investigation of the cost new and the present value of the railway properties, as of July 1, 1913, together with a study of the operation of the properties. The investigation was made to determine the value of the properties, including rights under franchises expiring in general on Sept. 1, 1921, in order to determine a fair price in case the city decides to purchase. The valuation includes both physical values and intangible values, the latter being the estimated present monetary values of the net profits, after all deductions for operation, taxes and interest. The Toronto Railway Company, it may be remarked, has practically a monopoly of the street-railway business of the city. It has been assumed in the Arnold-Moyes report that such rights as the suburban railway companies now have to distribute electrical energy for light, heat and power in a limited area in the city of Toronto shall be delivered to the city if the properties are purchased.

In a letter to Mayor Hocken supplementing the report, Mr. Bion J. Arnold says that if suggested conditions are complied with he believes that it will be well for the city of Toronto to enter into the proposed arrangement for purchasing the railways. This conclusion applies, however, to the local conditions only. Mr. Arnold says: "In thus advising I do not wish to be understood as taking any position whatever upon the broad question of municipal ownership and operation versus private ownership and operation, but am simply advising what I believe would be best for the city of Toronto, as a city, to do under the conditions that surround it at present."

In the Arnold-Moyes report the total value of the Toronto Railway Company is fixed at $20,608,036, of which $9,894,483 is the present value of the physical property as of July 1, 1913, and $10,713,553 is the intangible value of the property as of the same date. The total value of the portions of the property of the Toronto & York Radial Railway Company within the city is placed at $285,298, of which $91,604 is for physical property and $193,644 is for intangible value. The total value of that portion of the property of the Toronto Suburban Railway Company within the city is placed at $51,154. Thus the grand total value of all the railway properties, as fixed by the Arnold-Moyes report, is $20,944,478.

In arriving at the cost to reproduce the railways new, Messrs. Arnold and Moyes applied unit prices to inventory and added certain percentages. These percentages, varying from 5 per cent to 15 per cent, were for "organization," "engineering" and "incidentals." The average percentage was 6.4 per cent. There were also added 5 per cent for the cost of securing money and 5 per cent for carrying charges during construction work and general legal expense.

Depreciation percentages taken in the Arnold-Moyes report may be of interest. Some of them are as follows: Coal-handling apparatus, 6 per cent; grates and stokers, 50 (that is, 10 per cent a year for five years, no further depreciation being figured after that if the apparatus is still in use); horizontal tubular boilers, 8; water-tube boilers, 3.5; steel smoke breeching, 10; brick and concrete stacks, 3; heaters, 3 to 6; pumps, 5; air compressors, 5; Corliss slow-speed engines, 3; automatic high-speed engines, 5 to 8; piping, 3.5; generators, 4 and 5; transformers, 5; rotary converters, 5; switchboards and interior wiring, 3; iron poles, 2.5 to 3; cedar poles, 5; pole brackets, 4; wooden cross-arms, 5; iron cross-arms, 3.33; weatherproof cables, 3.33; lead cables, 3; transmission-line material, 5.

Mayor Hocken appears to be strongly in favor of the purchase of the street-railway and electric-service systems of the city for the total sum of about $30,000,000. The matter will undoubtedly come up for decision by vote of the electors of the city and, of course, arrangements will have to be made for financing if the project is indorsed by the citizens. The Toronto Electric Light Company has about 23,000 customers.

Railway Electrical Engineers at Chicago

By Telegraph

About 200 delegates, representing the electrical departments of the principal railroads of the United States and the allied manufacturing and supply interests, attended the opening sessions of the Association of Railway Electrical Engineers' convention, held at the LaSalle Hotel, Chicago, Oct. 21 to 24.

Following a brief address by President D. J. Cartwright, electrical engineer of the Lehigh Valley Railroad, the association adopted amendments to the constitution which will increase the list of eligibles, change the membership fees and affect the voting privileges of members. The committee on standard report-forms then submitted a system of reporting the performance of electrically lighted cars, which is designed to eliminate considerable clerical labor and to act as an automatic check on the work done by the different divisions of railway electrical departments. Mr. F. E. Hutchison, of Chicago, is chairman of the committee. Considerable discussion followed, during which several members described the systems of reporting employed by their respective companies. Mr. D. J. Cartwright, Phillipsburg, N. J., explained in detail the methods used by the Lehigh Valley road in reporting trouble, condition of storage batteries and electrical inspections.

Mr. Joseph A. Andreucetti, Chicago, secretary of the association, followed with the report of the committee on head-end equipment. This paper contained a general analysis of the construction and equipment used with head-end lighting systems and described the practice of several railroads in the lighting of cars. The committee urged that a standard type of head-end construction be adopted. The report was referred to the committee on standards in order that such action might be recommended if deemed desirable.

The report of the committee on terminal facilities for handling car-lighting equipment was next read by Mr. George B. Colegrove, Chicago. It described approved types of construction and equipment for battery houses and enumerated the kinds of tools required. Electric soldering irons and furnaces were recommended in preference to those heated by gas or charcoal. The use of electric trucks was also advised for transferring batteries between cars and battery racks. In the discussion which followed, the advisability of locating battery houses at terminal stations and at car shops was brought out. On account of the indefinite and infrequent periods at which cars are "shopped," some of the members favored terminal battery houses rather than those located in car shops. About an equal number of members favored the plan of cleaning batteries when the cars are in the shops. In all cases it was conceded that battery work should be in charge of competent electrical foremen. Among those taking part in the discussion were Messrs. Cartwright, Colegrove, E. S. MacNab of Montreal, D. B. Pastor of New York, Fred McGary of Chicago, and H. C. Meloy of Cleveland.

Tuesday's session closed with a report from the committee on electric head lamps, read by Mr. Charles R. Sugg, chairman. The report tabulates the laws in effect in different states regulating the intensity of locomotive headlamps. In most cases, however, the statutes require certain intensities at definite distances, without specifying the conditions under which these intensities shall exist. A wide divergence in requirements for head-lamp intensity is shown. The committee suggested that the association express itself as opposed to laws in which indefinite specifications are given. The report also contains a general description of electric head-lamp equipment and construction and includes forms for tabulating head-lamp performance and maintenance. The general opinion expressed was that the Interstate Commerce Commission should enforce a federal law giving head-lamp specifications comprehensive in character. Mr. Suggs explained that superintendents of motive power and master mechanics of a number of railroads are investigating this subject thoroughly at the present time.

A complete report of the papers and discussions presented at the subsequent sessions will be published in a later issue of the *Electrical World*.

The Railway Electrical Supply Manufacturers' Association held an elaborate exhibit of train and terminal lighting equipment in conjunction with the electrical engineers' convention. The display was considerably larger than in previous years, and each individual booth indicated the progress made in the development of appliances for the railway field. About fifty manufacturers were represented at the exhibition.

Signal Engineers at Nashville

The Railway Signal Association held its eighteenth annual convention at the Hotel Hermitage, Nashville, Tenn., on Oct. 14, 15 and 16. President B. H. Mann, of the Missouri Pacific, St. Louis, uttered a word of warning in his opening address. He said that a number of railroads have not adopted the association's standards and specifications. He urged individual work to bring about wider recognition of the approved methods of signaling adopted by the association. There should be less talk about the relative importance of this committee or that and more missionary work for the whole association.

A minute was adopted expressing regret at the sudden death of Mr. W. McC. Grafton, signal engineer of the Pennsylvania Lines West of Pittsburgh, on Oct. 10. Secretary C. C. Rosenberg, of Bethlehem, Pa., reported the membership to be 1209. The thanks of the association were extended to Mr. A. D. Cloud, of Chicago, editor of the *Signal Engineer*, and to the secretary for special work done for the association.

Alternating-Current Signaling

The report of the committee on electric railways and alternating-current signaling was presented by Mr. W. Morrison, of the New York Central, New York, in the absence of Mr. H. S. Balliet, of the same railroad. Specifications were presented relating to an alternating-current automatic block signal system, impedance bonds where alternating current is used for car propulsion and where direct current is so used, single-phase transformers for signaling, motors, relays, motor-generators, switchboards, etc. The specifications are applicable for this type of signaling as used on steam roads as well as electric roads. Mr. Howard, of the Union Switch & Signal Company, was called on for his advice on this rather complicated subject. The specifications were adopted for submission to letter ballot substantially as presented except that at the suggestion of Mr. W. H. Elliott, of the New York Central, the specifications for impedance bonds used in alternating-current signaling on railroads using alternating-current propulsion were labeled to show that they applied to 11,000-volt train-operating systems. It was also made clear that the figures given in brackets in the specifications are to be regarded as tentative. Mr. A. G. Shaver, of the Rock Island, Chicago, doubted whether the art of alternating-current sig-

naling has progressed far enough to warrant the making of recommendations for the manual, but nevertheless the committee's specifications were accepted for letter ballot as stated. A large part of the committee's report was devoted to descriptive matter relating to alternating-current signal systems on both electric and steam roads. There was no discussion on this part of the report.

Specifications for Wires and Cables

On recommendation of the committee on wires and cables, some changes were accepted in the specifications relating to mineral-matter rubber compound for signal wires. The galvanized messenger-wire specifications were also revised. New specifications for enameled copper magnet wire, virtually those used by the General Electric Company in making its own purchases, were accepted as presented except that it is stipulated that the diameter of the core of the spool on which the wire is wound shall be not less than 1.5 in. A letter was read from Mr. Hugh T. Wreaks, of the Wire Inspection Bureau, urging a more rigid inspection of signal wire.

Storage Battery and Charging Equipment

The committee on storage-battery and charging equipment presented its specifications for a pure-lead-type stationary storage battery for signaling. Mr. H. M. Beck, of the Chicago office of the Electric Storage Battery Company, objected to the new dimensions proposed as standard for lead plates for stationary signaling batteries. After some discussion the drawing and text references relating to these dimensions were withheld for further consideration, the remainder of the specifications being accepted for submission to letter ballot. In the discussion Mr. Clarence C. Bailey, of the General Electric Company, pointed out the necessity of using auto-transformers on the motor panels of battery-charging equipment.

Various Subjects Discussed

The committee on method of recording signal performance (Mr. W. N. Manuel, Grand Rapids & Indiana, chairman) was instructed to continue its work of preparing a revised form. A complete report is expected at the stated meeting of next March.

On request for an expression of opinion, nineteen members manifested a desire for an investigation of low-voltage switch-operating mechanisms.

The wire-crossing specifications of the Association of Railway Telegraph Superintendents were indorsed. These relate to aerial crossings over railroad rights-of-way of wires carrying not more than 550 volts.

Concluding Business

The next annual convention will be held in the Hotel Champlain, Bluff Point, N. Y., on Lake Champlain, beginning on Sept. 22, 1914, provided approval is obtained in a letter ballot. The entire hotel will be turned over to the convention. The setting ahead of the date may avoid conflict with the convention date of the American Electric Railway Association.

Officers were elected as follows: President, Mr. F. P. Patenall, Baltimore & Ohio; vice-presidents, Messrs. T. S. Stevens, Santa Fé, and W. J. Eck, Southern Railway; secretary and treasurer, Mr. C. C. Rosenberg, Times Building, Bethlehem, Pa.

Entertainment

The Signal Appliance Association, composed of affiliated manufacturers and dealers, did not make an exhibition, but instead gave a pleasing program of entertainment, consisting of buffet luncheons at the Hotel Hermitage, sight-seeing trips and a theatrical performance. On Oct. 17 nearly the whole party went to Chattanooga, and here the supply men were entertained by a trip to Lookout Mountain, buffet luncheon at the Hotel Patten and an excursion to Chickamauga Park and Fort Oglethorpe.

The total attendance at the convention was 410, including 115 ladies.

Public Service Commission News

Maryland Commission

The Postal Telegraph & Cable Company has petitioned the Maryland Public Service Commission to compel the American Telephone & Telegraph Company to sell its controlling interest in the Western Union Telegraph Company. Pending action by the commission the Postal company asks that the Telephone company be ordered to abolish the use of names for calls for the two telegraph companies. It asks that numbers be substituted and be used, as was the case several years ago before the Telephone company acquired its interest in the Western Union system. The Postal company asserts that discrimination is practised and that employees of the American company inform Postal customers that the latter's telephone lines are busy when they are free.

New Hampshire Commission

The Public Service Commission has authorized the purchase of the Cascade Light & Power Company, of Berlin, Gorham and Milan, by the Twin State Gas & Electric Company, of Dover, for $240,825. Under the decision rates in the territory involved in the purchase are not to be increased without the consent of the board. The commission has disapproved the petition of the Twin State company for authority to purchase the Berlin Electric Company for $172,000 but sanctions the transaction at $74,154. The board has authorized the Twin State company to purchase the Berwick & Salmon Falls Electric Company for $27,000 and has further approved the issue by the former of bonds not exceeding $1,232,000 par value to provide for the foregoing and other purchases authorized by the commission.

Wisconsin Commission

The Wisconsin Railroad Commission has authorized the Wells Power Company, of Milwaukee, to issue $136,000 common stock and $35,000 notes. The notes are to mature ten years from date and to bear 6 per cent interest. This is the first certificate granted under the new law which permits a corporation that is under-capitalized to raise the total of its outstanding stock, bonds, notes and other evidences of indebtedness more nearly to an equality with the value of its property. The commission found upon investigation that the value of the petitioner's property, including all leases and a reasonable sum for working capital, as $378,200. The sum of the outstanding stocks, bonds, notes, etc., is $207,000. The difference is provided for in the stock and notes which may now be issued.

The Wells Power Company is further authorized to issue $265,000 in 6 per cent notes, to be sold for not less than 75. The proceeds from the sale of $190,000 of the notes shall be used to retire $143,000 of demand notes now outstanding, which were issued for the construction and acquisition of the property now owned by the corporation. The proceeds of $75,000 of the notes shall be used to pay for extensions, additions and improvements to the plant and property.

That part of a recent order of the commission which denied the petition of the Citizens' Telephone Company, of Eau Claire, to issue and sell stock to enlarge and extend the plant of the Chippewa County Telephone Company, which it had acquired, has been declared unlawful in a decision rendered by Judge Stevens of the Circuit Court. The opinion stated that the court must follow the statute without regard to the question of whether it authorizes wasteful and useless duplication of plants, and that the question is one for

the Legislature and not the commission to determine. The commission denied the certificate on the ground that the Wisconsin Telephone Company already occupied the field and to permit a second utility to enter it in competition would be a violation of the statutes. Previous to its acquisition by the Citizens' Telephone Company the Chippewa County Telephone Company did practically no local business.

Massachusetts Commission

The Public Service Commission gave a hearing last week upon its recent tentative order requiring railway, trolley and telephone companies to file sworn monthly statements in detail as to funds exended for advertising, legal matters, legislative and general expenses. Representatives of the principal street railways and telephone companies appeared in oposition to the proposed order on the ground that the cost of such frequent statements would far exceed their value. Mr. Bentley W. Warren, counsel for the Massachusetts Street Railway Association, stated that no objections are held by the companies to the purpose of the order as it seems proper that the commission should secure all desired information, but that the board's powers of examination are sufficient to enable it to obtain data at all times and to any degree of detail desired. Mr. James F. Jackson opposed the order on behalf of the Bay State Street Railway, and Mr. E. K. Hall objected on behalf of the New England Telephone & Telegraph Company.

Indiana Commission

The Corydon Light & Water Company has petitioned the Indiana Public Service Commission for permission to sell its electric light, water and ice plant to the Interstate Public Service Company, which operates and owns many of the southern Indiana utility companies. The proposed purchase price is $26,500 plus a mortgage indebtedness of $14,500.

The Indiana commission has ordered the Central Union Telephone Company to reduce a new schedule of tariffs it filed for Marion County, raising the rates on telephones in state, county and city offices from $40 to $54 per year. The latter rate is the rate for business telephones. Commissioner John F. McClure declared in his opinion that city, county and state offices are entitled to lower rates than business houses, because of the public nature appertaining to their work.

A committee of auditors from the leading utilities of Indiana was appointed at a meeting of presidents and other officials of the companies on Oct. 16 to confer with the Public Service Commission of Indiana and attempt to reach a satisfactory conclusion in regard to questions which have arisen in connection with the proposed uniform system of accounts.

The Interstate Public Service Company filed a petition before the commission asking that it be allowed to keep all of its books and records in its headquarters at Indianapolis. It controls many utilities in the State. It showed that in order to introduce economies of service it needed some freedom in the matter. Several officials of other systems appeared before the commission at the same time as the representatives of the Interstate company. The result of the meeting was the appointment of the committee of auditors to meet with the commission and its accountants to settle the present difficulties and thereafter to handle other questions of a similar nature as they might from time to time arise.

California Commission

The Railroad Commission of California has directed the Pacific Telephone & Telegraph Company to reduce its rate for telephone service within the city of San José and neighboring territory. In its decision the commission eliminates the $5 deposit required for telephone service. The commission finds further that the company has been paying an abnormal percentage of its gross receipts to the parent company, the American Telephone & Telegraph Company.

Current News Notes

Commission Form of Government for Nashville.—The commission form of government succeeded the City Council of Nashville, Tenn., on Oct. 14. The latter body and its predecessors had been in existence more than 100 years. There are five commissioners. One, Mr. Hilary E. Howse, is Mayor. Nashville has a population of about 175,000.

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Useful Life and Smashing Point of Lamps.—In reporting certain remarks made by Mr. Ward Harrison in discussing his own paper before the Illuminating Engineering Society convention, we stated on page 619 of our issue dated Sept. 27 that the "useful life is independent of the energy cost or lamp cost." It was the "smashing point expressed in per cent of the initial candle-power" and not the "useful life" which Mr. Harrison said was independent of the energy cost or lamp cost.

* * *

General Electric Company of Budapest Twenty Years Old.—To mark the twentieth anniversary of the founding of the Budapest General Electric Company, of Hungary, Mr. Etienne de Fodor, its general director, on Oct. 9 tendered a banquet to about 150 of the most distinguished men of Hungary. Mr. de Fodor received an ovation following the speeches of the Minister of Commerce, Baron J. Harkanyi, and others. The occasion was a brilliant and extraordinary affair in which there was more than local interest.

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Sixty-Ton Electric Cantilever Crane.—A large cantilever crane is in use loading masonry blocks for building the harbor at Valparaiso. The crane lifts its full load of 60 tons at a distance of 52 ft. from its center in transporting blocks from the railroad to a barge moored alongside the jetty. The lifting motor is rated at 40 brake-hp, and there are two separate lifting motions each capable of dealing with loads of 7.5 tons and operated by two 30-brake-hp motors. This latter equipment permits the crane to deal with tipping skips, the intention being that the skip and its contents, weighing 15 tons, might be lifted by the two 7.5-ton hoists operating synchronously and tipped as desired by working them separately, each hoist being fitted with an independent brake. For the main hoist there is a powerful solenoid brake as well as rheostatic brake and a mechanical emergency brake.

* * *

Report on Chicago Railroad Terminals.—Mr. John F. Wallace, consulting engineer, presented his report on the railroad terminal situation in Chicago to the City Council committee on railroad terminals on Oct. 20. Mr. Bion J. Arnold is to present a report soon reviewing Mr. Wallace's findings. Mr. Wallace considered the seven routes of steam-railroad approach to Chicago and the six existing passenger terminals. He recommends two general locations for passenger terminals—one on the South Side near Michigan Avenue and Twelfth Street and one on the West Side near Canal Street and between Van Buren and Madison Streets. These would be in addition to the Chicago & Northwestern terminal at West Madison Street and Canal Street. A single union station is impracticable. Mr. Wallace recommends that the pending ordinance for the proposed Pennsylvania-Burlington-Alton-St. Paul union

station at West Jackson Boulevard and Canal Street be approved. The depression of freight tracks is advised in certain localities. No reference is made in the report to the electrification of railroad terminals.

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Ontario Water-Powers Under Commission Control.—At a recent meeting of the Ontario Municipal Electrical Association held in Toronto the following resolution was passed unanimously: "In view of the comprehensive schemes outlined by the Dominion government for the improvement of highways in connection with the St. Lawrence River, Welland Canal, French River, Sault Ste. Marie, Trent, Ottawa and others, involving a large expenditure of public money, and in view of the extensive power developments which are possible in consequence thereof, also in view of the rapidly increasing power requirements of the Province, be it resolved that this association request the Dominion government to put all such water-powers under the jurisdiction of the Hydro-Electric Power Commission of Ontario, to be developed by it for the use of the municipalities of the Province for the benefit of the people."

* * *

Canadian Electrical Exhibitions.—Two electrical exhibitions will be held in Montreal and Toronto respectively early next month. "Canada's First Electrical Exposition," which will have the active support and co-operation of the Montreal Light, Heat & Power Company, will be held at Montreal Arena, Nov. 1 to 8 inclusive, and the Toronto Electrical Show will be held in the Arena Gardens, Toronto, from Nov. 10 to 15. In the Montreal exhibition a representative showing will be made by manufacturers, dealers and jobbers of electrical supplies and appliances for the purpose of demonstrating to the public all modern uses of electricity in the home, factory and office, also in medicine and surgery, as well as in many other departments. The purpose of the Toronto exhibition is to give the exhibitors a means of advertising and selling to the public, including central-station men and the entire electrical trade of Toronto and the Province of Ontario.

* * *

Eggs Fried on Ice.—Considerable attention was attracted to the booth of the Ozone Pure Airifier Company at the International Refrigeration Exposition by the demonstration of frying eggs on ice. This feat was not performed to demonstrate any device manufactured by the company but to call attention to the apparatus which it had displayed and, as the representative in charge jokingly said, to show that even more difficult things than purifying air with ozone can be accomplished. Although bystanders offered several explanations of the phenomenon, they were usually wrong. As a matter of fact, the aluminum plate on which the egg was fried was heated by induction. In a case beneath the slab of ice (which was 2 in. or 3 in. thick) was an auto-transformer. A person holding his hand over the ice could feel no heat and the griddle was cold to begin with. By placing the aluminum griddle on the ice over the coil, however, alternating currents were induced to flow in it, and the metal became heated.

* * *

Attitude of Forest Service on Utilization of National Forest Lands.—In our issue dated Sept. 6, on page 467, it was stated, in connection with a suit brought by the Pacific Gas & Electric Company against the Secretary of Agriculture, that "the Forest Service objects to further elevation of the reservoir on the ground that the water will overflow parts of the Tahoe National Forest. It also opposes the construction of an aqueduct across the forest reserve." We have learned from official sources that the Forest Service does not object to the construction work which the company is doing or to the flooding of national forest lands for reservoir purposes, provided only that the company will comply with the requirements of the law under which such use of national forest lands may be permitted. This the company has so far declined to do, claiming that the act of Feb. 15, 1901, under which a permit might be secured is unconstitutional. The Forest Service therefore has not even had the opportunity to pass upon the question of issuance of the permit for the construction work which the company contemplates.

* * *

SOCIETY MEETINGS

Chicago Electric Club.—Captain C. C. Healy of the Chicago traffic police addressed the members of the Chicago Electric Club Oct. 16 on the subject of traffic regulation in Chicago's "loop" district, comparing American methods with those of the police departments of European countries.

* * *

Special Train to Electric Vehicle Convention.—En route to the Electric Vehicle Association convention at Chicago with several carloads of delegates from New York City, Boston and Philadelphia, a special all-steel train is scheduled to leave the Grand Central Terminal, New York City, at 8:02 p. m. Saturday, Oct. 25, reaching Chicago at 9 o'clock Sunday evening. The fourth annual convention of the Electric Vehicle Association of America will be held at the Hotel LaSalle, Chicago, Oct. 27 and 28, as announced in last week's issue, which reproduced the program for the two-day session.

* * *

Officers of Signal Appliance Association.—At Nashville, Tenn., on Oct. 15 the Signal Appliance Association elected officers for the ensuing year as follows: Chairman, Mr. W. P. Hawley, New York, United States Light & Heating Company; vice-chairman, Mr. L. T. Thomas, Chicago, General Railway Signal Company; secretary and treasurer, Mr. F. W. Edmunds, New York, Dressel Railway Lamp Works. Executive committee—Messrs. W. J. Gillingham, Chicago, Hall Switch & Signal Company; George H. Porter, Chicago, Western Electric Company; W. T. Kyle, New York, Duplex Metals Company, and F. E. Cameron, Corning, N. Y., Corning Glass Works. Committee on convention arrangements—Mr. E. E. Hudson, Orange, N. J., Thomas A. Edison, Inc.; Mr. Cameron and Mr. George Blackmore, New York, Union Switch & Signal Company. Committee to confer on place of convention—Mr. Gillingham. This association is the manufacturers' auxiliary to the Railway Signal Association.

* * *

Montreal Electrical Society.—The winter season of the Montreal Electrical Society began on Oct. 6, and meetings will be held during the winter on the first and third Mondays of each month. Some of the papers to be presented before the society during the year are as follows: "X-Rays," by Mr. L. R. McDonald, of the X-Rays, Ltd., Nov. 3; "Telegraph Talk," by Mr. W. J. Camp, assistant manager of the Canadian Pacific Railway telegraph department, Dec. 1; "Rolling Metal Equipment," by Mr. C. A. Ablett, general manager Siemens Company of Canada, Ltd., Jan. 5. Prof. A. M. Gray, of McGill University, Montreal, will address the society on Feb. 16. "Recent Advances in Illumination" will be the topic of Mr. C. A. Howe on March 2. Mr. W. C. Lancaster, electrical engineer for the Canadian Northern Railway Tunnel, has promised a paper, and Mr. Coombes, of the Babcock & Wilcox Company, will speak on "Boilers." Mr. F. C. Burrett, of the Canadian Cement Company, will speak on "Industrial Applications." No dates have been assigned to the last three speakers.

The Waterside Turbine Station at Louisville, Ky.—I

Special arrangement of condensing equipment in pit 53 ft. below turbine-room floor—Labeling of electrical circuits—Consolidating the physical equipment of former competing companies

SINCE the consolidation of the various gas and electric interests in Louisville, Ky., by H. M. Byllesby & Company, the combined utilities have been operated under the name of the Louisville Gas & Electric Company. This merger represents a combination of five electric generating systems, two of which were originally operated by the Louisville Lighting Company and the remaining three by the Kentucky Electric Company, the George G. Fetter Lighting & Heating Company and the Campbell Electric Company respectively.

The several electric distributing systems are now being rearranged to be fed from the merger company's Waterside station (formerly the plant of the Kentucky Electric Company) and the former Louisville Lighting Company station in the interior of the city. These two plants will be connected by tie-lines and the remaining small generating stations shut down. Where, as the result of the recent competition, duplicate distribution lines traverse identical territories the plans will be to continue in use only the newer equipment to serve the entire district.

Features of Design and Construction

Of the two large generating plants to be operated by the merger company, the Waterside station on the river front is the more modern, having been erected only a year ago. Designed for an ultimate rating of 64,000 kw, one 4000-kw and one 2000-kw turbine unit are already installed, and extensive additions are now being planned.

From an engineering viewpoint, the feature of the former Kentucky Electric Company plant is, however, its unusual arrangement of condenser equipment, made necessary by the 45-ft. rise and fall in the stages of the Ohio River at Louisville. To meet this difficulty the extraordinary departure adopted was that of installing the condensers at the bottom of a concrete well extending 53 ft. below the turbine-room floor, from which location they are connected with the turbine exhausts by 60-in. pipes dropping vertically from the turbine casings.

The plot on which the station is located measures 305 ft. wide and 396 ft. long. It is adjacent to the Ohio River and also to spurs of the Louisville & Nashville and Illinois Central railroads, so that any one of these means may be used for bringing in the station's coal supply. For distribution purposes the plant is desirably located, being within one-half mile of the electrical load center of the city. Should it ever be required to furnish steam for district heating, it

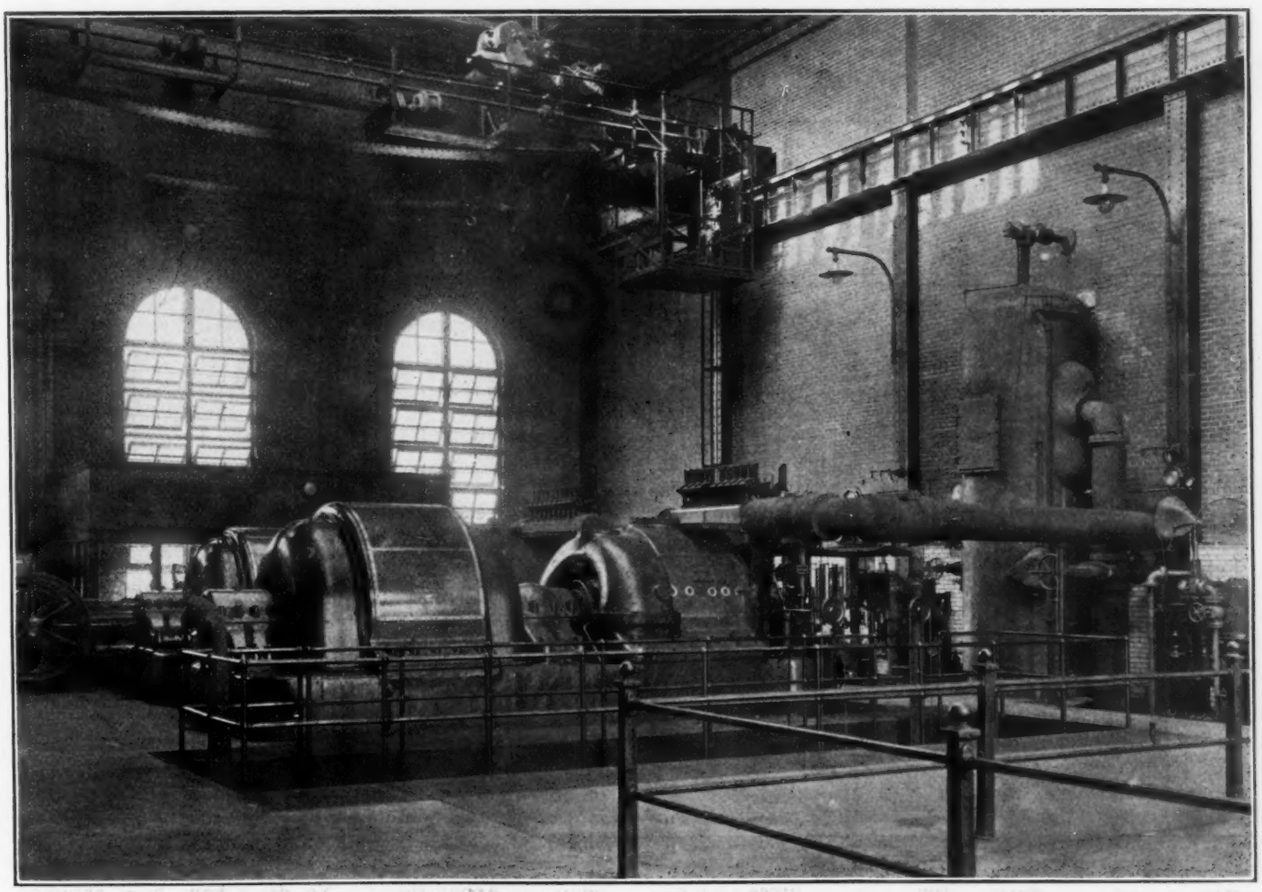


FIG. I—TURBINE ROOM OF WATERSIDE STATION, LOUISVILLE GAS & ELECTRIC COMPANY, LOUISVILLE, KY.

will also be within 1500 ft. of the probable center of demand.

The portion of the Waterside station already completed measures 134 ft. wide and 107 ft. long, and is three stories high, not including its basement and roof penthouse. The floors of the boiler room, turbine room and switchboard room are all on the same level. Two galleries and the penthouse located above the switchboard room are occupied by the switch compartments, bus compartments and lightning-arrester equipment.

Boiler Room

The boiler room is of special interest because of the comfortably low temperature maintained under operating conditions due to its design. Three batteries of two boilers each are arranged in a single row at present, but ultimately the building will be widened 27 ft. to accommodate another row. The Babcock & Wilcox boilers installed, each having 5087 sq. ft. of heating surface and 103.5 sq. ft. of grate area, develop steam at 200 lb. pressure. Superheats as high as 125 deg. Fahr. can be maintained by the superheaters installed in each boiler, although the degree of superheat is varied according to the load carried. Each unit is equipped with a chain grate, operable by either an electric motor or a steam engine.

At one end of the firing aisle is a load-indicating device controlled from the switchboard, which shows the fireman the electrical load which is being carried or which it is expected to carry, in order that demands on the boilers may be anticipated. The rectangular case, 6 ft. high and 1 ft. wide, has a glass front on which figures are printed indicating the load in steps of 500 kw. The figures are large enough to be easily discernible from the opposite end of the firing room, and behind each division is an incandescent lamp. The switchboard operator can by the same means inform the fireman in advance whether the load is going to increase or decrease and when another turbine is about to be started up.

One 250-ft. steel stack arranged centrally with relation to the existing boilers carries aloft the combustion gases. This stack has a minimum diameter of 12 ft. and is lined with firebrick throughout its entire height. At the bottom the lining is 6 in. thick and at the top 4 in. thick. The space between the lining and the stack proper is filled with grout to prevent the steel from being corroded by moisture. As additional boilers are installed new stacks will be erected, the plan being to provide one stack for each set of six boilers.

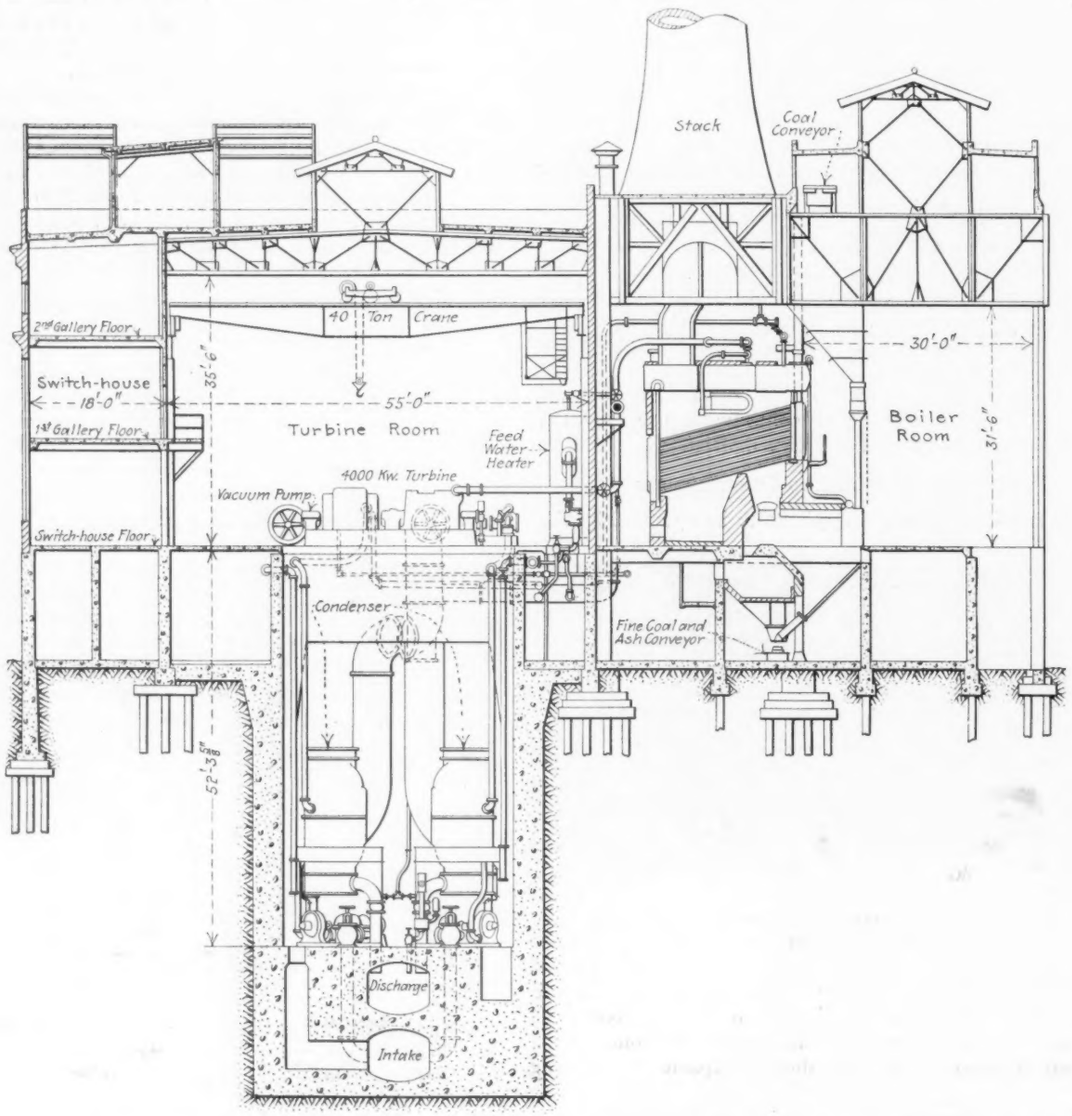


FIG. 2—ELEVATION CROSS-SECTION OF WATERSIDE STATION, SHOWING CONDENSER PIT AND CIRCULATING TUNNELS

Boiler-feed water can be supplied either by two reciprocating pumps or by a centrifugal pump, all placed in the turbine room. The reciprocating pumps are of the Worthington

marine type and are capable of delivering 275 gal. per minute each. The four-stage centrifugal unit is driven by an Alberger Curtis turbine and delivers 450 gal. per minute. Water required for the boilers in excess of that obtainable from the hot wells is passed through two Jewel filters. The water used in the cooling jackets of the vacuum pumps and the turbine bearings is also passed through these filters.

Coal-Handling Equipment

As already mentioned, coal can be received by boat or by rail, but facilities for unloading river barges have not yet been developed. Except during the recent flood, all fuel has been received by rail, the cars being dumped into concrete bunkers beneath the tracks. Mounted on a turntable on the roof at the north end of the plant and above the level of the bunkers is an Orton-Steinbrenner hoist with a 1.5-cu. yd. bucket which raises the coal from the bunkers to a crusher on the roof. This crusher was in-

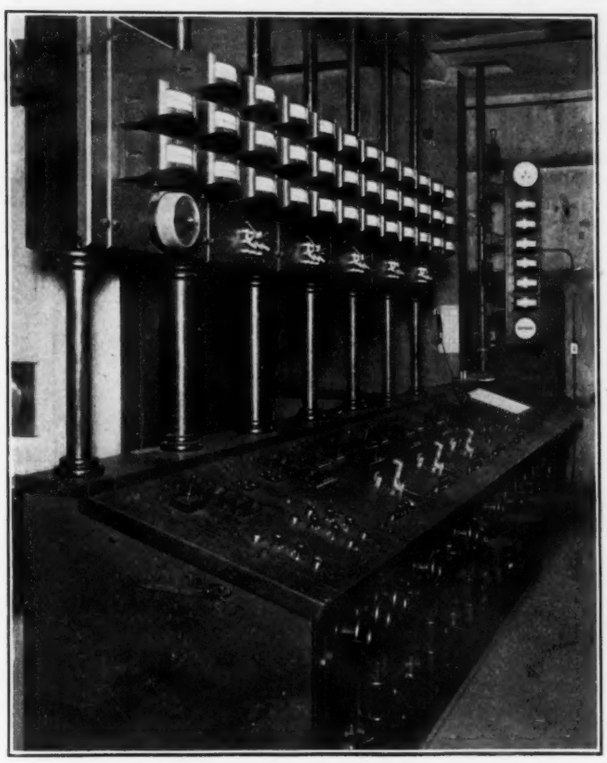
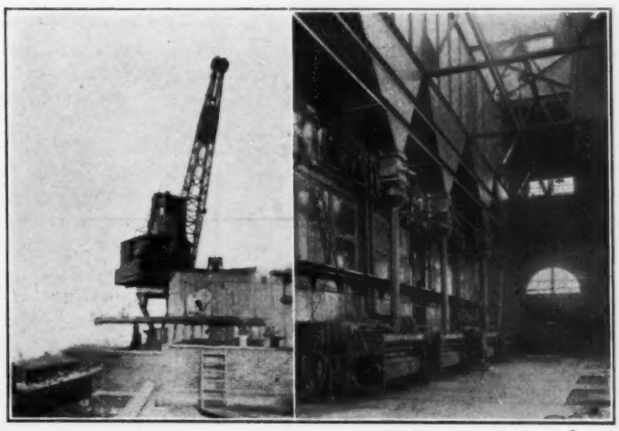


FIG. 3—CONTROL BENCHBOARD, SHOWING WATTLESS COMPONENT SWITCHES BELOW METERS

stalled with the intention that "run-of-mine" coal should be used at some future time, although Western Kentucky coal containing 11,550 lb.-Fahr. heat units per pound is being used at present. The crusher is capable of handling 65 tons of fuel per hour.

When other than mine-run coal is used the crusher rolls are separated and the coal is allowed to pass directly through the machine onto a Robbins belt conveyor, which travels over the 65-ton coal bunkers located above the boilers in the firing room. This 24-in. belt conveyor is equipped with a traveling tripper, which permits unloading all the coal into one hopper or unloading into several in succession. The coal hoist, crusher and belt conveyor are operated by 220-volt, three-phase, wound-rotor induction motors. The motor operating the coal hoist is rated at 112 hp, and the motors on the crusher and belt conveyor are rated at 30 hp and 5 hp respectively. Ultimately an elaborate coal-handling device will be installed, with an electric traveling crane spanning the whole coal yard.

Ashes, as well as fine coal which sifts through the chain grates, are delivered to separate compartments beneath the grates. In the basement beneath these compartments is a 30-in. six-ply belt conveyor which is at different times used for disposing of the ashes and fine coal. A twenty-four-hour run of ashes can be thus disposed of in fifteen minutes. The ash conveyor discharges into concrete ash bunkers outside of the plant, from which the ashes are loaded



FIGS. 4 AND 5—COAL HOIST ON ROOF OF STATION, AND BOILER ROOM

into cars by the coal hoist, already referred to above.

Header Arrangement to Avoid Steam Traps

To avoid the use of steam traps, an ingenious arrangement of drainage for the high-pressure steam mains has been adopted. There are two steam headers, the main header and the auxiliary header. For each of the main generating units a large connection is taken from the main header, dropping vertically down to the level of the turbines and then passing horizontally through the division wall. From the bottom of each of these elbows a smaller pipe continues down to feed the auxiliary header located in the turbine-room basement.

From the top of this auxiliary header steam is taken for all the auxiliaries located on the main floor, and from its

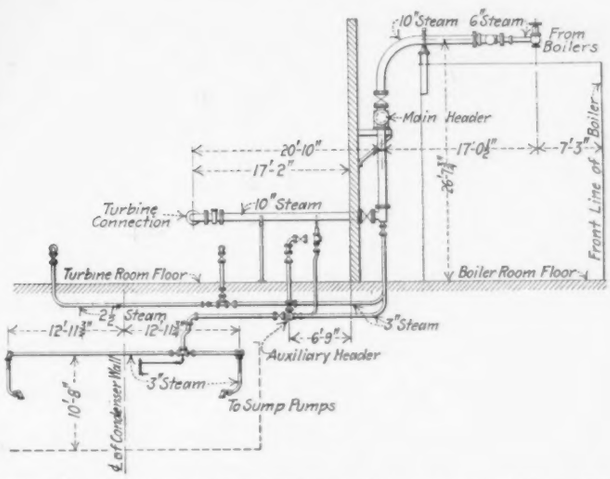


FIG. 6—ARRANGEMENT OF STEAM PIPING WHICH ELIMINATES STEAM TRAPS

bottom two connections are made to feed the turbine-driven pumping units located in the condenser well. Below these pump connections the pipes continue down to feed the slow-speed reciprocating service pumps, 53 ft. below the level of the turbine-room floor. All water thus eventually reaches the service pumps, where it can do no damage, being disposed of through their exhaust.

Turbine-Room and Condensing Equipment

Adjoining the boiler room on the west is the turbine room, which measures 65 ft. wide and 107 ft. long, having been designed for the immediate installation of four 4000-kw turbo-generators. Only two units are installed at present—one is rated at 2000 kw and the other at 4000 kw—but it is expected that additional sets will be installed shortly. Both of the present units are 2300-4600-volt General Electric alternators, driven by Curtis horizontal turbines running at 1800 r.p.m. With the aid of the 2300-4600-volt windings, as soon as the high-tension distribution district enlarges, the machines will be connected to supply 4600 volts.

As already mentioned, the arrangement of the condensing equipment in this plant is quite extraordinary, as made necessary by the 45-ft. rise and fall in the level of the Ohio River, from which the circulating water is obtained. To accommodate this varying level, the main turbine condensers are themselves installed at the bottom of a 30-ft. concrete well, 53 ft. deep, opening into the center of the turbine-room floor. The condensers are connected with the turbines by vertical 60-in. exhaust lines. The one pit provides condenser space for four turbine sets, as it was feared to excavate additional pits which might give the building too large displacement during floods. Details of construction of the condenser pit, with the tunnels for water supply, are shown in the cross-section sketch of the plant reproduced herewith.

Intake from the river is through a screen well on one corner of the plant property. This well is built of concrete and is situated 535 ft. from the concrete intake cribs in the river. Its tunnel connections with the condenser pit are also illustrated by drawings herewith. Two 42-in. concrete pipes extend from the well to the water line of the river, where they connect to two cast-iron flanged pipes with flexible joints, which extend to concrete cribs located 75 ft. apart in the river. Here the pool level is ordinarily maintained at 412 ft. above sea level by the government dam below Louisville, but the intake pipes are so placed that they would remain covered with water even if the dam should be carried away by floods or ice.

The screen well is separated into two compartments by a concrete wall, each section connecting with one of the pipes leading into the river. The screens are placed diagonally across each compartment. Leading from the well to the condenser pit are two arched-roof concrete tunnnels, the discharge tube being superimposed upon the intake tube. Since the top of the upper tunnel is about 5 ft. below low-water mark, the siphon principle is utilized to assist in circulating the water through the condensers. By an arrangement of valves, the pipes leading to the river can alternately be made intake and discharge tunnels, enabling sediment that collects in them to be removed by reversing the direction of flow.

The condensing equipment installed in the pit comprises a pair of vertical-tube double-pass condensers, each having a total of 10,000 sq. ft. of cooling surface. They were especially designed for this plant and are made up of 1-in. tubes of No. 18 gage, 14 ft. 9 in. long. Both condensers were designed for 4000-kw machines, although the one used with the 2000-kw unit contains only 6000 sq. ft. of tube area. Sixty-inch pipes connect the turbines with the condensers, the exhaust steam passing through a steam dome from which it flows across the condenser while the air is removed on the opposite side.

Each condenser is provided with an Alberger-Curtis turbine driving a 20-in. tri-propeller circulating pump and a 4-in. two-stage hot-well pump on the same shaft. The tri-propeller pump is capable of supplying 9000 gal. of water per minute, and the hot-well pump delivers 200 gal. per minute.

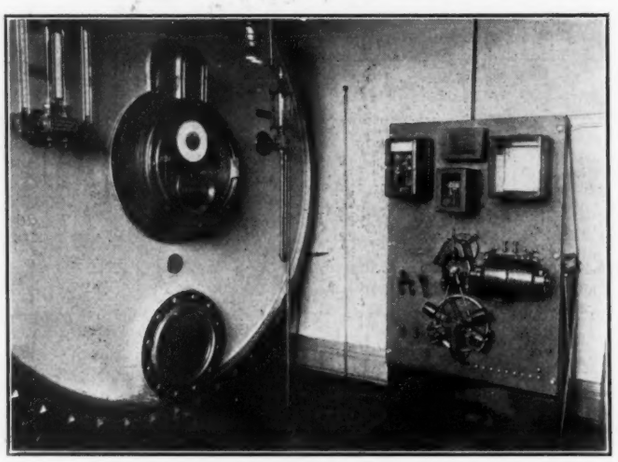
On the main floor there is a rotative dry-vacuum pump which is connected with the condenser by an 8-in. pipe. Tests have shown that the circulating pump is required to overcome a friction head of about 7 ft. under normal conditions, giving a vacuum within 1 in. of the barometer.

To ascertain the condition of the screens in the intake well, floats are installed in the tunnels and connected to graduated tapes brought up through vertical pipes to the engine-room floor and counterbalanced by weights. By reading the tape markings the difference in level of the water in the pipes is obtained, which corresponds to the friction head required to force water through the tunnels and screens. It is hoped to perfect this apparatus, making a recording device which will chart its own readings.

The second part of this article, which is to appear in a subsequent issue, will describe the electrical equipment of the Waterside station, giving a detailed account of the switching apparatus, bus layout, facilities for making tests, system of labeling and use of colored wire, and other features of special interest in connection with the plant.

Electrically Operated Gas Meter at Waterloo, Ia.

Shown herewith are the two station meters used by the Citizens' Gas & Electric Company of Waterloo, Ia., for recording its output of illuminating gas. The large "wet" meter on the left measures only the "water gas" manufactured, while the electrically operated meter, whose control mechanism is shown on the right, integrates the entire output, both water gas and coal gas. In comparison, as will be seen, the electrical device occupies little space,



STATION GAS METERS AT WATERLOO, IA.

although it has a capacity of 100,000 cu. ft. per hour, four times that of the huge wet meter. The electric meter is of the Thomas type, built by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., and was installed last March. Its accuracy has been tested with Pitot tubes, and found satisfactory under varying pressures and temperatures.

In its operation the Thomas meter utilizes the principle of heating electrically, through a small fixed temperature rise, the gas traversing its measuring chamber. The temperature of the gas before and after passing the heating grid is determined by two electric resistance thermometers which control relays, adjusting the current flowing through the main heater grid so that the temperature difference will be held constant at all times. The energy required to maintain constant temperature rise at various rates of flow is thus proportional to the quantity of gas passing, so that the electrical power taken by the heater becomes an index of the number of cubic feet of gas traversing the meter. A watt-hour meter on the panelboard reads directly the total cubic feet of gas, and a curve-drawing ammeter makes a continuous record of the rate of gas flow.

Application of Electric Drive in Greenhouses

Extensive use of motors, both alternating and direct-current, in a large floral establishment near Chicago—Operation of refrigerating machines, fertilizer unloaders and pumps, soil mixers, etc.

AMONG the industrial applications of electric drive which show decided economies over other forms of motive power is the use of motors in greenhouses. Constructed as they are with only one story, such hothouses are of necessity distributed over considerable ground area. To lay steam mains sufficiently large to care for future steam-engine installations or to install additional piping as new engines are required is unsatisfactory. Moreover, the radiation and friction loss attending such long stretches of pipe present additional objections to the use of steam.

Gasoline engines, on the other hand, have not met with the approval of the owners of some greenhouses, owing to the malingering attitude of workmen, who take advantage of the prevailing notion that gasoline-engine service is unreliable. Instances have occurred where engine adjustments have been purposely tampered with or an overload put on the engine until it stopped. Sometimes as many as twelve or fourteen laborers, whose continuous occupation depended on the operation of the engine, would assert that they knew nothing about starting it and would remain idle until the engineer or a mechanic was summoned to start the machine. The electric motor, with its protective devices, its absence of any fine adjustments which can be tampered with and its simplicity of operation, has therefore been increasingly applied to various phases of the flower and plant-growing industry.

The greenhouse owned by the Poehlmann Brothers Company, of Chicago, is located at Morton Grove, Ill., a suburb north of Chicago. The hothouses cover an area of about 2,000,000 sq. ft. and are arranged in two groups, A and B, separated by approximately 3000 ft. Three heating plants are located on the grounds, two at Plant A and one at Plant B. Twenty-four high-pressure boilers are installed in these plants, and steam pressures of 85.5 lb. and 5 lb. per square inch are maintained for engine and heating purposes respectively. In all, 1500 hp can be developed by boilers of the water-tube type, and 2600 hp can be developed by fire-tube boilers. Electricity for operating apparatus in Plant A and in its proximity is supplied by a private generating plant operated by the company. Energy for Plant B is furnished by the Public Service Company of Northern Illinois.

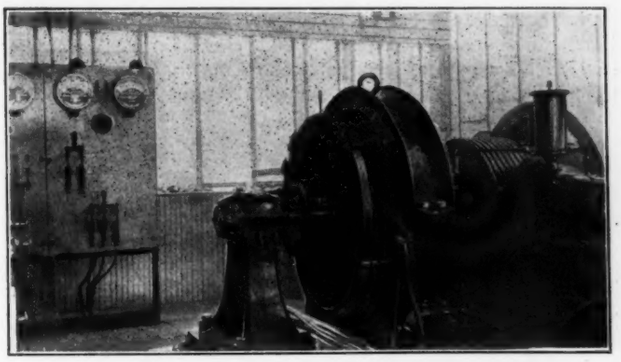


FIG. 1—GENERATING ROOM AT POEHLMANN GREENHOUSES

Power House and Coal-Handling Device

One of the heating plants at Plant A, completed recently, contains six boilers in batteries of pairs, and space for six additional units. Coal for the boilers is brought to the plant in freight cars over a spur of the Chicago, Milwaukee & St. Paul Railroad. The cars are pulled up a 7 per cent grade to a track which is located 16 ft. above the level of the firing aisle, and from this point are dumped into bins beneath the tracks. The coal in these bins is accessible for hand firing in case the automatic apparatus which is used for filling the stokers should fail to operate. Ordinarily the coal is hoisted from the bins to the overhead bunkers by electrically operated bucket conveyors. There are three of these conveyors, one for each pair of boilers. The coal is fed to the stokers from the overhead bunkers by gravity through individual spouts. One 5-hp shunt-wound motor is belted to a shaft running the full length of the firing aisle. Any one of the coal hoists can be operated from this shaft by moving a lever which engages a friction clutch.

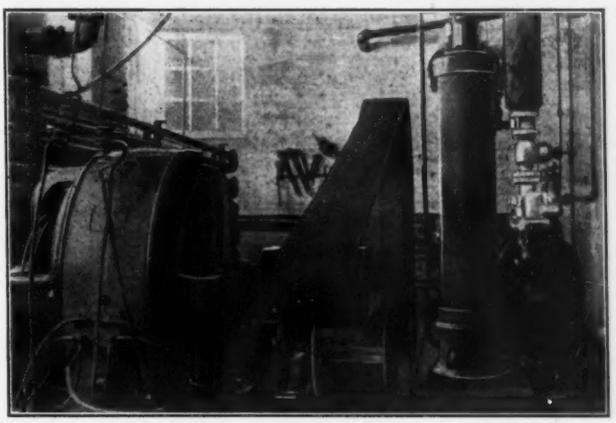


FIG. 2—MOTOR REFRIGERATING MACHINE

Two 30-kw, 250-volt direct-current Thompson-Ryan generators are installed at Plant A, being directly connected to McEwen reciprocating steam engines, each rated at 58 hp. The generators are 3.5 per cent over-compounded and show no evidence of sparking at 50 per cent overload. The switchboard consists of two panels, one for each machine, on which are mounted voltmeters, ammeters and the necessary line switches.

The direct current thus generated is transmitted at 220 volts to the various distribution centers of Plant A by overhead lines carried on insulators supported on poles and on the peaks of the hothouse roofs. Terminal boxes, connected with these distribution lines, are also located on the ends of the hothouses, about 100 ft. apart, so that electricity is available for portable apparatus outside of the buildings.

Refrigeration at Plant A

The refrigeration apparatus at Plant A is located about 1000 ft. from the generating station and is near the cold-storage and shipping rooms. A 15-ton Linde ammonia compressor driven by a 25-hp General Electric shunt-wound

motor is installed in this room. The motor has been in continuous service for five years, and it is said that the repairs have amounted to only 80 cents in that time. Water for cooling the ammonia condenser coils is pumped from two 1500-ft. wells on the premises by the air-lift principle, at the rate of 800 gal. per minute from each well. Compressed air for operating the wells is supplied by a Bury compressor belted to a 10-hp Northern Electric Manufac-

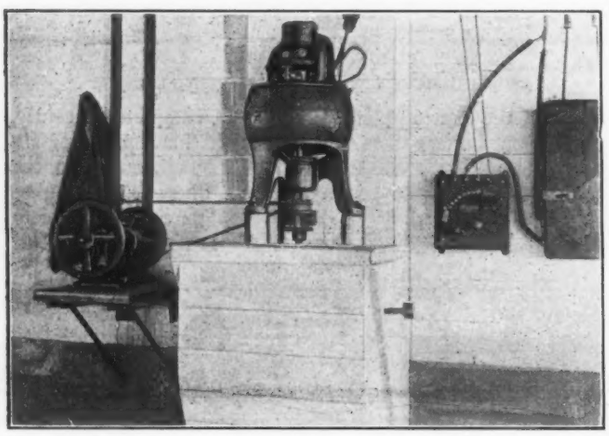


FIG. 3—MOTOR-DRIVEN BRINE CIRCULATOR AND COLD-AIR BLAST

turing Company's shunt-wound motor. The water direct from the wells has a temperature of about 56 deg. Fahr. and would be too cold for watering the flowers in the hothouses. Returning warm water from the ammonia condensing coils is therefore drained into a 115,000-gal. storage reservoir, from which it is pumped to the various watering taps throughout the greenhouse.

Refrigeration is required in two cold-storage rooms, in the bloom-chilling room, and for making artificial ice. Immediately after cutting the flowers it is necessary to put the blooms in the bloom-chilling room, where the air is cold and dry. This precaution is necessary in order to prevent the flowers from turning blue or blighting. An air draft is maintained by a ventilating fan directly connected to a 1.5-hp Northern Electrical Manufacturing Company's motor. The fan is inclosed in an air shaft, in the outlet of

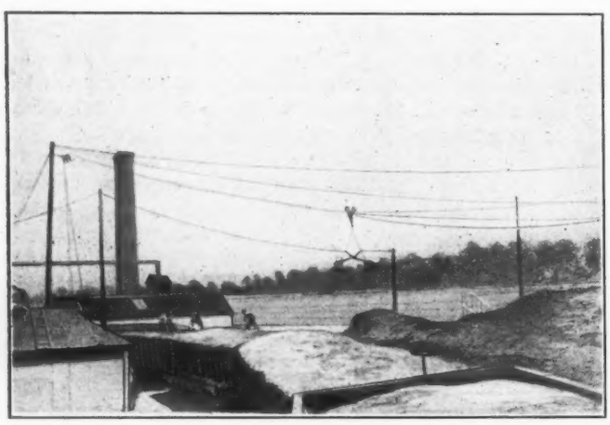


FIG. 4—ELECTRIC FERTILIZER UNLOADER

which are calcium-brine cooling coils. Belted to the motor which drives the fan is a brine-circulating pump, which keeps the cooling coils at the proper temperature. The circulating fan is capable of supplying 1000 cu. ft. of air per minute, which is maintained at 38 deg. Fahr.

The cold-storage room is used for storing roots of perishable plants or bulbs. This company imports lily-of-the-valley "pips," which have to be kept in a cool place. At present there are 1000 cases, each containing 2000 of these pips, stored in the cold-storage rooms. The air in the rooms is kept at a temperature of about 25 or 28 deg. Fahr. by direct-expansion coils.

Fertilizer Unloader and Liquid Pumps

For storing the fertilizer, which is shipped to the grounds in freight cars, several thousand square feet of concrete platform are used. On account of the extreme heat generated by the decomposition of the fertilizer during the summer months, it has been found impossible to hire a sufficient number of laborers to unload the fertilizer from the cars on hot days. For this reason a motor-driven mechanical unloader has been devised which dispenses with the human element in the process of unloading. Six 30-ft. tubular steel poles were erected at various points in the fertilizer stack and stranded galvanized-iron wire cables are stretched from these poles over a spur of the railroad track to a single pole erected near the track but on the opposite side from the other poles. A "grapple fork" (the action of which is similar to that of a grab-bucket) is supported from wheels which can be run along the cables from the car containing the fertilizer to the stacks. The grapple fork is operated by a 10-hp, 220-volt Robbins & Myers electric motor housed in a small wooden structure erected at the foot of the pole from which the six cables radiate.

The pressure of the fertilizer on the lower layers of the stack causes the richest part of the fertilizer to be pressed

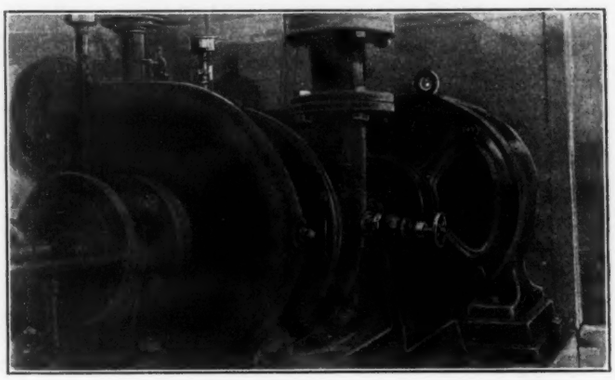


FIG. 5—MOTOR-DRIVEN LIQUID FERTILIZER PUMP

out in the form of a liquid. This liquid is drained into a storage tank from which it is pumped back onto the stack to impregnate the remainder of the fertilizer. The pump is of the centrifugal type and is operated by a 5-hp General Electric motor. A float switch installed in the drain tank makes the operation of the motor entirely automatic.

Electric Soil Mixers

Different mixtures of soil and fertilizer are required for the different species of flowers. To facilitate the mixing of the soil, an electrically operated soil-mixing machine was designed and constructed under the supervision of the company's engineer, Mr. E. G. Goodwin, who is also to be credited with the other applications of motor drive which have been made. The latest design of this apparatus consists of two traveling belts and a rotary mixer, which are connected by gears or chains and sprockets to a 5-hp, 220-volt motor. One of the belts is fed with fertilizer and earth by men standing on each side of the machine. This belt conveys its charge to the rotary mixer, which in turn deposits the mixed material on the second belt. The latter belt travels at a slightly faster speed than the first one as the mixed soil occupies more space than the original constituents. The frame supporting the second belt can be adjusted in its position so that the mixed soil can be deposited on any desired stack.

Three of these machines have been constructed by the company and have given perfect satisfaction, whereas similar machines driven by gasoline engines were not satisfactory for the reason mentioned in a foregoing paragraph. The machines are portable and can be transported to any part of the field in which a mixture of soil is desired. The motor is inclosed in a small wooden case supported on a steel frame consisting of 8-in. channel irons. This frame also supports the intermediate reduction gears, which reduce the speed from 1100 to 90 r. p. m., and in addition the rotary mixer and the two ends of the traveling belts. In the case with the motor are the starting switch, with the necessary fuses, and the reduction gears. A terminal box is secured to the outer wall of the motor housing, from which a cable can be run to one of the terminal boxes on the walls of the greenhouse already described.

Another mixing machine is to be constructed soon and will be equipped with an alternating-current motor which can be operated from the Public Service mains at Plant B. When the latter is completed the company will own two alternating-current and two direct-current machines each of which can do the work of about ten men.

Central-Service Supply to Plant B

The electrical equipment at Plant B is supplied with energy from the Public Service Company's mains through three 50-kw General Electric transformers installed on the premises. The voltage is stepped down from 2200 volts to 220-110 volts and is distributed on lines supported on insulators in a manner similar to that used at Plant A. The applications of electric drive are similar to those at Plant A, with the exception that Allis-Chalmers alternating-current motors are used instead of direct-current motors.

The refrigerating plant at Plant B consists of a 10-ton Boland ice machine driven by a 10-hp wound-rotor-type induction motor. The motor is equipped with the usual starting device and speed-control apparatus. Being located in a vestibule through which there is considerable traffic, the motor is fenced off from the remainder of the hallway by a guard screen. The refrigeration at this plant is all accomplished by direct expansion instead of by brine circulation.

All of the fertilizer used in Plant B has to be conveyed

FIG. 6—ELECTRIC SOIL-MIXING MACHINE (FIRST TYPE)

in wagons from Plant A, as the railroad spur has not been extended into this vicinity. Practically all of the fertilizing which is done in this plant is accomplished by forming a water solution of the fertilizer and circulating it through pipes in the same way as water to taps located at different points in the greenhouse.

Wagons containing the solid fertilizer are pulled up inclined tracks made of angle irons and are unloaded into tanks 25 ft. wide, 50 ft. long and 7 ft. deep. The contents of the tanks, or "boilers" as they are called, are submerged in water and live steam is allowed to circulate through the mass. The heat of the steam kills any germs or insects which might be harmful to plants and the bubbling of the steam agitates the mass so that the water soon becomes a saturated solution of fertilizer.

There are three of these tanks, and a separate track runs

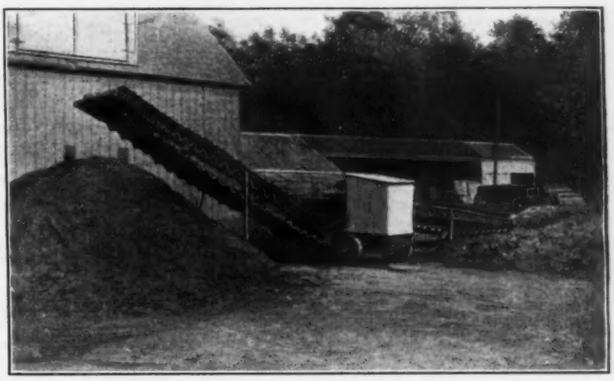


FIG. 7—ELECTRIC SOIL-MIXING MACHINE (IMPROVED TYPE)

up over each one. One 5-hp squirrel-cage motor is used for pulling the wagons up any pair of these tracks. The motor is belted to a shaft, which runs across the upper end of the tracks and in turn may be connected to the car-pulling cable drums by friction clutches. In case the friction clutches fail to release when a wagon is pulled to the top of the tracks, a foot lever is operated which opens the line switch on the motor.

When a concentrated solution of the liquid fertilizer is obtained it is drained into a 1000-gal. reservoir below the surface of the earth at the northern end of the greenhouse. Over this reservoir is a small wooden structure housing a motor-driven centrifugal pump. The pump is used to convey the liquid fertilizer from the tank to the different taps throughout the Plant B greenhouse. The motor has a rating of 30 hp, and the pump is capable of supplying 300 gal. per minute. Because of the regularity of the flow and the absence of hammering which sometimes accompanies the use of reciprocating pumps, it has been found feasible to run the liquid fertilizer mains on overhead supports through the greenhouse, and no vibration has been noted.

Mr. Goodwin, the company's engineer, declares that there are various other possibilities of applying electric drive around a greenhouse and says that more improvements are contemplated in the future at the Poehlmann plants. In addition to the apparatus already mentioned, there is a 5-hp motor in the machine shop which drives all of the machines through belting. The lighting load consists of about 600 lamps, some of which are 16-cp carbon lamps and the rest are 50-watt tunsten units.

Smoke Damage in Cities

According to a recent smoke-loss investigation conducted by the University of Pittsburgh, the economic cost of the smoke nuisance in Pittsburgh is about $10,000,000 a year, or about $18 per capita per annum. Mr. John O'Connor, Jr., author of the report, asks the people of Pittsburgh to believe that black smoke is not the economic asset that they have long held it to be. Mr. O'Connor mentions the investigation by Mr. Paul P. Bird, formerly smoke inspector in Chicago, to show that the smoke damage in that city is over $7 per capita per year, and the researches of Mr. E. P. Roberts, consulting engineer, Cleveland, to show that the corresponding figure in that city is over $10.

Radiant Energy and the Eye

Where energy is absorbed and how the factor varies with luminous efficiency for various parts of the eye. By M. Luckiesh

NOT all the radiant energy which enters the eye is active in the process of producing the sensation of light. No doubt it is fair to assume that at least this "inactive" energy is absorbed by the eye media and transformed into heat. This should cause an increase in temperature in the eye, which has led some to hold that this is the cause of irritation and fatigue. Dr. Steinmetz

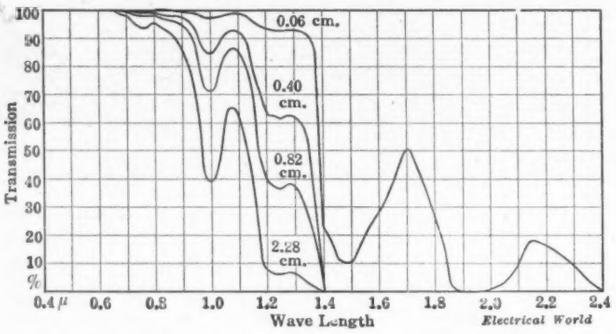


FIG. 1—TRANSMISSION OF VARIOUS LAYERS OF WATER CORRESPONDING TO THE EYE MEDIA

says: "The harmful effect of working very much under artificial illumination is largely due to this energy effect." Others share this belief, but the writer is unaware of any data on the subject which serve to support this conclusion.

There is a general feeling that artificial light is more fatiguing than daylight, which contains far less energy per lumen-second than the light from ordinary artificial illuminants. Of course, if it be true that artificial light under the same conditions of diffusion, intensity, surroundings, retinal adaptation, etc., is really more irritating and fatiguing than daylight, it is wise to look to the spectral character of the radiation as a probable cause. However, there are no actual data which prove that artificial light is more discomforting than daylight when all conditions excepting the spectral character of the radiation are the same. Prof. C. E. Ferree[1] has found natural light from windows to be less fatiguing than illumination from a glaring installation of tungsten lamps, but the conditions were far different in the two cases. However, he has later stated that a difference was found between carbon and tungsten lamp installations of the same character, the light from the carbon lamps being more fatiguing.

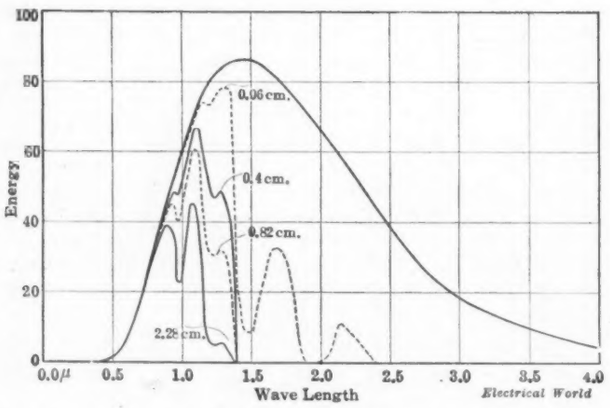


FIG. 2—TRANSMISSION OF RADIANT ENERGY FROM A 4-WATT-PER-CANDLE CARBON LAMP THROUGH VARIOUS LAYERS OF WATER

Any one familiar with the spectral distribution of energy in the radiation from ordinary light sources is certain that less energy per lumen is incident upon the eye as the temperature of the radiator is increased, provided that the light is due to purely temperature radiation. The computations in this paper will be confined to purely temperature radiation or radiation from bodies which deviate but little from it. Just what relative amounts of energy are absorbed in the various eye media and how the amount of absorbed energy varies with the temperature of the source have not been determined, although Vogt[2] has described elaborate experiments which show roughly the transmission of the eye media in various regions of the spectrum. His results roughly confirm the more refined experiments of Aschkinass.[3]

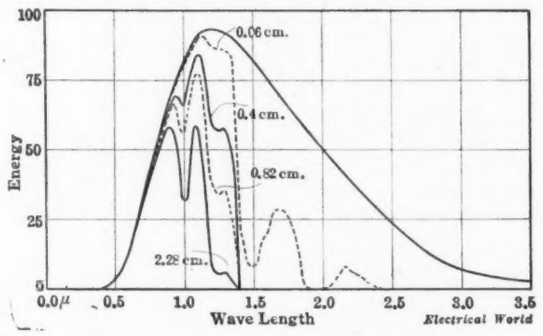


FIG. 3—TRANSMISSION OF RADIANT ENERGY FROM A 1.25-WATT-PER-CANDLE TUNGSTEN LAMP THROUGH VARIOUS LAYERS OF WATER

Fortunately, Aschkinass has clearly established the transmission of the eye media throughout a wide spectral range and has obtained other data which enable certain computations to be made. He found that the various eye media transmitted the visible and infra-red rays in the same manner as like thicknesses of water. The only discrepancies found were for the transmission of the cornea for the visible and "near" infra-red rays. The differences found in that case he attributed to the film which rapidly forms over the dead cornea, rendering it less transparent, for the absorption bands were well defined and in the same position as for water.

The intensity of radiation after traversing any depth, d, can be computed from the following equation:

$$I' = Ie^{-\epsilon d}$$

where I and I' are the original and final intensities re-

[1] *Trans.* Ill. Eng. Soc., January, 1913.
[2] *Graefe's Archiv.*, 81, 1912, page 155.
[3] *Ann. der Physik*, Bd. 55, 1895, page 401.

spectively, e is the base of Naperian logarithms, and ϵ is the extinction coefficient. This can be further simplified for purposes of calculation thus:

$$\frac{I'}{I} = T = e^{-\epsilon d}$$

where T is the transmission coefficient. If I is taken as unity, of course the value of I' is numerically equal to the transmission coefficient. Aschkinass gives a table of extinction coefficients for water for radiant energy of wave-lengths from 0.45 μ to 8.49 μ. It is thus possible to compute the transmission of the various eye media for this range of wave-lengths. Aschkinass did this for the total eye but not for the various media. For the purpose of computation thicknesses of water corresponding to the various eye media were taken. These are reproduced in Table I on this page.

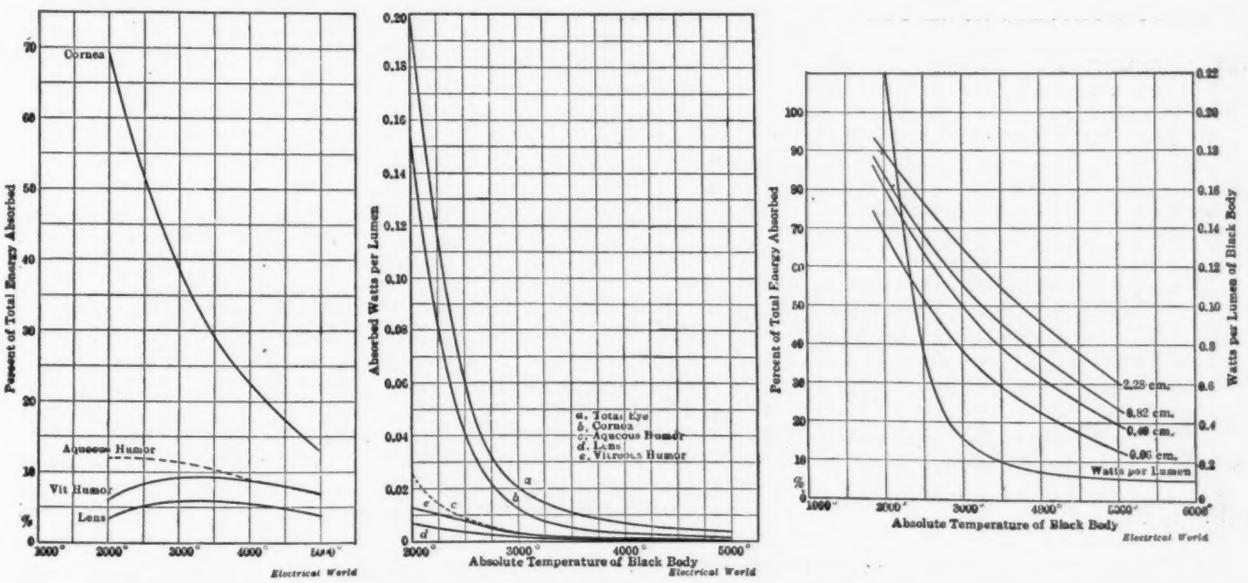
Transmission curves were really obtained for four thicknesses of water, namely, 0.06 cm, 0.4 cm, 0.82 cm and 2.28 cm. The first thickness corresponded to the cornea, the next to the cornea plus the aqueous humor, and so on. Obviously the amount of energy absorbed in the aqueous humor is readily found by obtaining the absorption of the first two thicknesses and taking their difference. This was the general procedure. The transmission curves of the four thicknesses of water are shown in Fig. 1.

The next point of interest was to apply these transmission curves to the curves representing the spectral energy distribution of black bodies at various temperatures and also to those of various illuminants. This was done by multiplying the ordinates of the energy curves by the corresponding transmission coefficients. Figs. 2 and 3 show the results of this process with the energy curve of a 4-watt-per-candle carbon incandescent lamp and that of a 1.25-watt-per-candle tungsten lamp respectively. The numbers on the curves represent the thickness of water. For instance, the percentage of total energy radiated from the carbon lamp which is transmitted by the cornea is found by obtaining the ratio of the area under this curve (0.06 cm) to the total area under the radiation curve. The difference between this and unity gives the absorption of the cornea. The same process with the curve 0.4 cm gives the percentage of energy transmitted by the cornea and aqueous humor. Obviously the difference between the two transmission ratios gives the percentage of total energy absorbed in the aqueous humor and so on. These percentages are found in Table II and plotted in Figs. 6 and 4 for black bodies at temperatures ranging from approximately 2000 to 5000 deg. C. absolute. At temperatures above 5000 deg. the ultra-violet energy becomes appreciable, so no computations are given for higher temperatures. The curves would rise again for temperatures beyond 5000 deg. The energy of shorter wave-length than 0.35 μ radiated from a black body at 5000 deg. absolute was found to be 3.8 per cent of the total energy.

TABLE I—THICKNESSES OF WATER CORRESPONDING TO VARIOUS EYE MEDIA

	Cm. of Water
Cornea	0.06
Aqueous humor	0.34
Crystalline lens	0.42
Vitreous humor	1.46
Total depth of eye	2.28

Though the eye media are found to transmit the visible and infra-red rays in the same manner as water, this is not true for ultra-violet radiation. Water is transparent to short-wave radiation far into the extreme ultra-violet. In fact, no noticeable absorption was found for any of the ultra-violet radiation from the mercury arc in a quartz tube. It has been concluded by some that ultra-violet light is chiefly absorbed in the eye lens owing to the fact that it strongly fluoresces under the influence of these rays. This conclusion has been strongly confirmed by spectro-photographic evidence. However, for black-body temperatures below 5000 deg. absolute the ultra-violet rays need not be considered from the standpoint of the temperature effects due to absorption of this energy. In Fig. 4 are plotted the percentages of total black-body energy absorbed by the various eye media. It will be noted that for the cornea these percentages rapidly decrease with increase of temperature of the source, but much less rapidly for the aqueous humor, while the percentages of absorbed energy are a maximum for the lens and vitreous humor at about 3500 deg. absolute. This would hardly be foreseen without computation. It is seen that most of the energy is absorbed in the outer portion of the eye. In reality this absorption rapidly decreases as the depth of the absorbing layer increases. This, of course, is to be expected from the ex-



FIGS. 4, 5 AND 6—PERCENTAGE OF TOTAL RADIANT ENERGY ABSORBED IN VARIOUS EYE MEDIA, WATTS ABSORBED IN EYE MEDIA PER LUMEN IN USUAL PERCENTAGE OF LIGHT, AND PERCENTAGE OF TOTAL RADIATED ENERGY ABSORBED IN VARIOUS LAYERS OF WATER

potential character of the foregoing equation relating thicknesses of the eye media with the transmission coefficient.

So far only percentages of energy absorbed have been considered. However, it is important to reduce the data to a common basis, that is, to find the actual watts absorbed per lumen. This was readily done by combining the foregoing percentages with the lumens per watt of the various sources. In Fig. 6 are plotted the values of watts per lumen for the black bodies at various temperatures. Multiplying these values by the corresponding values from the curves in Fig. 4, the actual watts absorbed per lumen are found in each case. These values are plotted in Fig. 5. Curve *a* represents the absorption for the total eye (2.28 cm of water), curve *b* that of the cornea. Curves *c*, *d* and *e* represent respectively the absorption of the aqueous humor, lens and vitreous humor. These data are also found in Table III. These curves indicate the actual power absorbed in the eye media per lumen of light flux in the entering beam. The computations considered only a beam of light of such dimensions that it enters the pupil; however, the exterior portions of the eye must absorb much energy in rays which could not possibly enter the pupillary aperture. The cornea and aqueous humor, besides absorbing most of the energy in the useful beam, no doubt thus absorb a great deal more energy.

amount of short-wave radiation. This, however, is not of interest here, because a large amount of the short-wave radiation would not be tolerated on account of its destructive effect. It will be noted that about thirty times as much energy is absorbed in the total eye per lumen of tungsten light as per lumen of light from a black body at 5000 deg. This same ratio would hold approximately for sunlight if it were not for the moisture in the atmosphere which absorbs much of the infra-red rays before they reach the eye. This is perhaps fortunate considering the enormously greater intensities of illumination encountered in daylight. For instance, according to F. E. Fowle,[4] the amount of precipitable water existing in the form of water vapor between the top of Mount Wilson and the outer limits of our atmosphere during fair weather from June to November, 1910 and 1911, was found to vary from 0.2 cm to 2.8 cm. The average quantity present was 0.69 cm.

TABLE II—PERCENTAGE OF ENERGY ABSORPTION

Source	Percentage of Total Energy Absorbed in							
	Water of depth				Cornea	Aq. Humor	Lens	Vit. Humor
	0.06 Cm.	0.4 Cm.	0.82 Cm.	2.28 Cm.				
Black body at 2000 deg. absolute	68.8	80.6	83.8	89.7	68.8	11.8	3.2	5.9
Black body at 2500 deg. absolute	51.7	63.3	68.3	76.7	51.7	11.6	5.0	8.4
Black body at 3000 deg. absolute	38.5	49.8	55.7	65.1	38.5	11.3	5.9	9.4
Black body at 4000 deg. absolute	22.8	31.7	37.2	45.9	22.8	8.9	5.5	8.7
Black body at 5000 deg. absolute	13.0	19.6	23.4	30.4	13.0	6.7	3.8	7.0
4-w.p.c. treated carbon lamp	64.1	77.3	81.0	87.9	64.1	13.2	3.7	6.9
1.25-w.p.c. tungsten lamp	50.4	64.5	70.5	80.0	50.4	14.1	6.0	9.5

Another point worthy of consideration is the energy density at various points in the eye along the pencil of rays. Obviously owing to the optical system through which the pencil passes the energy density varies in different parts of the eye. Where the energy is more concentrated the more serious effects might be expected.

This paper does not support or condemn the theory that the power absorbed causes fatigue and irritation. Its object has been to show where the energy is absorbed and how the factor varies with luminous efficiency for various parts of the eye.

TABLE III—ABSORPTION IN WATTS PER LUMEN

Source	Watts per Lumen Absorbed in							
	Water of depth				Cornea	Aq. Humor	Lens	Vit. Humor
	0.06 Cm.	0.4 Cm.	0.82 Cm.	2.28 Cm.				
Black body at 2000 deg. absolute	0.153	0.179	0.186	0.20	0.153	0.026	0.007	0.013
Black body at 2500 deg. absolute	0.04	0.049	0.053	0.061	0.04	0.009	0.004	0.008
Black body at 3000 deg. absolute	0.012	0.0156	0.0174	0.0202	0.012	0.0036	0.0018	0.0028
Black body at 4000 deg. absolute	0.0035	0.0049	0.0057	0.0071	0.0035	0.0014	0.0008	0.0014
Black body at 5000 deg. absolute	0.0015	0.0023	0.0027	0.0035	0.0015	0.0008	0.0004	0.0008
4-w.p.c. treated carbon lamp	0.247	0.297	0.312	0.338	0.247	0.05	0.0015	0.026
1.25-w.p.c. tungsten lamp	0.064	0.082	0.089	0.101	0.064	0.018	0.007	0.012

It is thus seen that the outer layer of the cornea absorbs a large portion of the energy which is not active in producing the sensation of light, and, as is to be expected, the absorbed energy per lumen of light flux incident upon the retina rapidly decreases with increase of temperature of the source. There would be an increase again for temperatures higher than about 6000 deg. due to the increasing

The writer acknowledges the assistance of Mr. Leonard Krill, who made many of the computations used in this article.

[4] *Astrophysical Journal*, June, 1913.

Central Station Management

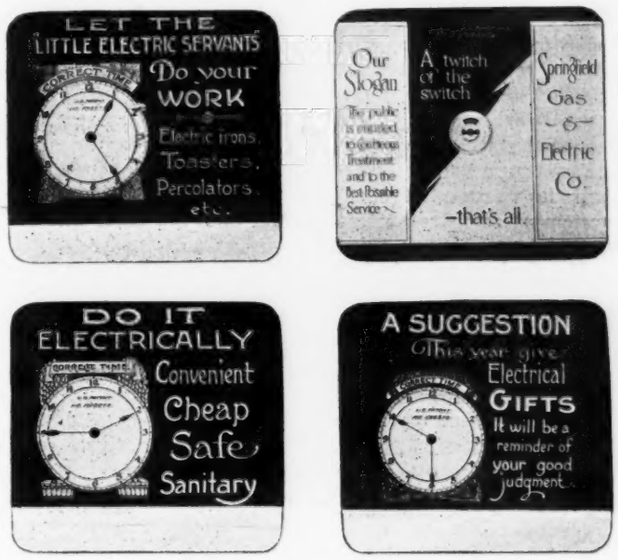
Devoted to Discussion of Administrative Policies, Commercial Methods, and Current Practice Among Successful Utilities

County Newspapers and Twenty-Four-Hour Service

County newspapers throughout the central district of Kentucky are discarding former methods of operation in favor of electric drive since the Kentucky Utilities Company has arranged for twenty-four-hour service to both lighting and motor-service customers in those communities. The *Henry News*, at Eminence, and the *Anderson News*, at Lawrenceburg, have recently put in motor-driven equipment, and other papers in that part of the State are following the example thus set them.

Advertising Slides for Moving-Picture Shows

Ever alert for novel advertising ideas, the Federal Light & Traction Company, New York, recently sent out to all of its subsidiary companies several sets of lantern slides with an imitation clock attachment for giving the correct time. These slides are being used in local motion-picture theaters, and the central-station managers report excellent



LANTERN SLIDES FOR MOTION-PICTURE SHOWS

publicity results from the novelty. A photograph of one of the slides is reproduced herewith.

The slides show the dial of a clock with two small movable hands affixed thereto. In his booth the picture-machine operator ascertains the correct time, sets the hands of the clock accordingly, and the slide is then flashed on the screen for the benefit of the audience.

Such moving-picture shows are well supported by women, most of them without watches, and the clock slides are of value in giving the correct time. Patrons carrying watches often strain their eyes in the darkness trying to read from their own timepieces, so that the slides are greatly appreciated by this class of the public. The advertising value of the slides to central stations can therefore readily be seen.

The Levi Perfection Slide Company, 1560 Broadway, New York, controls the patent to the clock slide, although, according to Mr. H. W. Alexander, publicity manager of the Federal company, the cost of the slides, notwithstanding that they are protected by patent, is very low.

Peak-Period Supply to Municipal Plant

Arrangements are being discussed between the municipal lighting board of Westfield, Mass., and the Amherst Power Company for the purchase of hydroelectric energy by the town plant between the hours of 5 p. m. and 8 a. m. The growth of electrical service at Westfield has forced the board to consider plans for either purchasing additional service or securing an appropriation of $25,000 for a new turbo unit boiler and chimney installation at the local station. The power company offers to deliver electricity to the town at 1.3 cents per kw-hr., the cost of manufacture at the municipal plant being now 2.2 cents.

According to the plan which is now undergoing consideration, the town will appropriate $8,000 for the construction of a receiving transmission line between the local plant and the town boundary, where a 750-kw transformer and metering station will be located. The Amherst company will deliver energy to the town at 13,200 volts. By running the town plant on a nine-hour daily shift during the period of its greatest economy of operation and purchasing energy for the remaining fifteen hours each day, it is estimated that the municipality will save at least $2,000 per year in the operating and other expenses connected with the municipal installation.

Cost of Repairs and Maintenance of Electric Trucks

Following an inquiry conducted from the office of this journal among central-station companies that operate electric vehicles in their own service, the accompanying figures have been chosen from the returns received in reply to questions concerning unit costs per mile for the maintenance and repairs of batteries, tires and cars. The results as tabulated show little consistency, for the cars referred to were performing a variety of service and were working under various conditions of paved streets, steep grades, etc.

COST OF REPAIRS AND MAINTENANCE OF ELECTRIC TRUCKS

	Average Miles per Day	Cost, in Cents per Mile		
		Batteries	Tires	Car
700-lb. wagon	7	2.9	1.1	1.9
750 lb. delivery wagon, lead cells	20	8	1	....
1000-lb. truck	16	5.6	2.1	0.5
2000-lb. truck, lead cells	21	3.9	1.7	1.9
2000-lb. truck, lead cells	15	14.6	3.9	2.9
3000-lb. truck, nickel-iron cells	18	1.5	0.9	3.9
7000-lb. truck, lead cells	22	3.2	6.7	8.2
Five cars and trucks, 3000-lb. to 700-lb., lead and nickel-iron cells	35	2.8	2.5	1.0
Thirteen cars and trucks, 750-lb. to 4000-lb., lead, and nickel-iron cells.	35	2	2	2

In the instances where the battery-repair charge was high it was usually noted that renewals or extensive replacements of plates and parts had been made.

To secure significant maintenance results it is, of course, desirable that all parts of the equipment should have previously gone through an entire cycle of renewal, including the replacing of tires, renewal of cells, repainting, etc. Such a complete cycle requires in any event from two to three years of service, and it affords the only basis on which to place a conservative estimate of electric-vehicle operating costs. Until the improved modern electric truck is a little older in commercial use it will be difficult to obtain such figures in numbers which make possible useful comparisons.

Refrigeration and Central-Station Service

At the last session of the fourth section of the International Congress of Refrigeration held in Chicago on Sept. 23 Mr. Charles J. Carlsen, of the contract department of the Commonwealth Edison Company, read a paper entitled "Refrigeration in Central-Station Service." He said that in Chicago alone there are at present nine large ice-making plants, with an aggregate rating equivalent to 1900 tons of refrigeration and a connected load of 3628 hp, supplied with energy by the central-station company. In addition, refrigerating machines of various sizes, having a rating of about 2625 tons and a connected load of about 5500 hp, are operated by central-station electrical energy. The total of this central-station load in Chicago is 4525 tons of refrigeration and 9128 hp.

Mr. Carlsen pointed out that the most difficult refrigerating business for the central station to obtain today is undoubtedly that where exhaust steam may be used as a by-product. But only a short time ago a large packing concern in Chicago "signed up" for central-station service covering not only its refrigerating equipment but electric service for its entire factory as well. Here the saving in investment and operating expenses more than offset the exhaust-steam value. Excessive value is sometimes given to exhaust steam; engineers are learning more about such things from day to day. Even the absorption plant is not immune from central-station influence. A recent investigation of a 100-ton (duplicated) absorption plant, with all auxiliaries electrically operated from an isolated plant, showed an annual saving of nearly $500 when the entire plant was operated from the central station. This saving was exclusive of overhead charges.

Some of the advantages of central-station electric service cannot be set down in dollars and cents. This refers, among other things, to continuity of operation and readiness-to-serve twenty-four hours of every day throughout the year. Simplification of bookkeeping and general supervision are items seldom taken into account but recognized by customers after they have been on central-station service for a time. Another advantage is that the customer has the advice and assistance of technical and engineering men in working out his problems. Again, the installation of equipment can usually be made in a manner suitable to available space requirements. Furthermore, with electric operation it is possible to meter the various loads so as to determine absolutely the cost of operation in each branch of the industry.

The author concluded by giving tabulated data on several refrigeration and ice plants in various parts of the country using central-station service.

Mr. A. B. Grubmeyer, of the Consolidated Gas, Electric Light & Power Company, Baltimore, opened the discussion. In considering the possible use of central-station energy he said that owners of refrigeration and ice plants should give careful consideration to three points. These are the present tendency toward increase in the cost of labor, the tendency toward increase in cost of fuel, and the general agitation in relation to smoke nuisance and the allied annoyances of coal haulage and ash cartage. The tendency in the case of electric service is toward lower rates. The ice manufacturer need have little fear that central-station rates will be increased. In Baltimore the company will take contracts for five, ten or twenty years with a guarantee that the rates will not be increased during that time, also pledging the customer that he shall get the benefit of any reduction in rates that may be made. Where central-station energy is used the amount of labor required in the machine end of ice plants is relatively small. Furthermore, it is possible to locate plants in many residential districts where steam plants would not be tolerated. Mr. Grubmeyer said that there seems to be a tendency toward the use of the raw-water can system of producing artificial ice. Most large cities have a practically pure water supply, and satisfactory ice should result from the freezing of this water.

Mr. Carlsen commented on the fact that the Commonwealth Edison company in its studies leading up to the present contract offered to ice manufacturers had discovered that the 80-ton plant is the most economical. This size of plant forms the basis of the figures offered in the existing form of contract. It is an interesting coincidence that Mr. Peter Neff, consulting refrigeration engineer of Canton, Ohio, in his paper read at the congress on "The Cost of Manufacture in Distilled-Water Ice Plants," also found that the 80-ton plant is the most economical to operate, all things considered.

Mr. R. H. Tait, of St. Louis, a consulting refrigeration engineer, said that if the central-station companies would guarantee the cost of energy for a term of years that fact would certainly have considerable weight with owners of plants. However, it is to be remembered that the owners have to consider the cost of their existing steam plants. As to raw-water versus distilled-water ice, Mr. Tait remarked that the question as to which type of plant is to be used is determined by commercial considerations entirely. In some places it is cheaper to distil water than to put in a raw-water plant. In other cases good ice can be obtained and the question of purity of the ice obtained from one system as compared with the other does not enter into the problem to any great extent.

Mr. Carlsen remarked that there are more distilled-water ice plants electrically operated in Chicago than raw-water plants.

Mr. Tait made the point that the low rates offered by the central-station companies in large cities are not available in the smaller towns.

Mr. Peter Neff, of Canton, Ohio, said that each refrigeration or ice plant must be studied on its own merits as to power requirements, as well as in relation to other conditions. The purchase of electrical energy will receive consideration from many engineers wherever possible.

Selling Display Window Lighting "on Trial"

The method of the "free-trial offer," which has proved so successful in other forms of merchandising, has been extended by the Denver Gas & Electric Light Company to the promotion of electric show-window lighting.

After getting permission from the proprietor or manager of a given business establishment to allow a trial window-lighting installation to be put in his store, the company dispatches one of its wiremen to the job with instructions to follow the wishes of the owner in the arrangement of the lamps. Installations are in this way made in stores even where no service is yet available, the window lighting being temporarily supplied through stage cables connected to the service mains outside.

The display lighting is then operated on trial for a week, during which period a man is stationed outside the store to

count both the number of passers-by and the number of those who stop to look in the window. These data, when compared with similar data taken before the window illumination was installed, invariably furnish conclusive evidence of the value of electric show-window lighting in increasing the sales of merchants who install it.

Electric Cooking with a Unity-Load-Factor Range

At the recent Cedar Point convention of the Ohio Electric Light Association an interesting talk and demonstration of electric cooking by the stored-heat principle was given by Mr. M. E. Turner, contract agent for the Cleveland Electric Illuminating Company. The cooking outfit on exhibition during the convention consisted of one 300-watt range, two 300-watt stoves and one 200-watt compartment cooker. Ten of these sets were built by hand at the General Electric Company's factory and have been distributed among as many central stations in the United States for demonstration purposes. The outfit shown was installed and used in Mr. Turner's home in Cleveland for three months, during which time all of the family cooking was done by means of electricity.

The continuously connected stove is about the size of an ordinary gas range, and contains an oven but no griddle heaters. The oven interior is lined with an iron casting about 1 in. thick which stores the heat received during twenty-four hours of the day from a heating cartridge inserted from the back of the range and sealed to prevent heat radiation. Between the casting and the outer casing of the stove there is placed about 2 in. or 3 in. of heat-insulating material. At the top of the oven is a broiling device which consists of an 1100-watt grid-heating unit. The switch controlling the broiler is located under the oven door in such a position that the latter cannot be closed without shutting off the broiler element, the heat of which might prove destructive in the tightly closed oven. With continuous supply of energy to the regular oven heater, a temperature of 600 deg. Fahr. is maintained in the oven.

Each of the two 300-watt stoves are vertical cylindrical bodies containing about 190 lb. of cast iron apiece, which is used to store the heat continuously supplied by a heating unit placed near the bottom of the stove. The casting terminates at the top of the stove in a sort of griddle on which the various cooking utensils can be set. When the stove is not in use a hinged insulated cover prevents radiation of heat from the iron casting.

The compartment cooker is in outward appearance similar to the stoves, but when the insulating cover is raised, the cavity in which to set the compartment cooking utensils is seen.

Central-Station Steam-Heating Costs Under Average Conditions

Data on operation of combination steam-heating and electric-lighting plants showing steam-heating auxiliaries to be highly profitable and desirable were presented at a recent convention of the Atlantic Gas & Electric Company by Mr. W. H. Yeomans, of the Eastern Pennsylvania Power Company, Easton, Pa. His figures, given in the accompanying table, were taken from the daily report of an Eastern central station where the revenue derived from the sale of steam for heating paid the total operating cost of the station for the month and left a net balance of $1,160.23.

Aside from direct profit, as exemplified above, the combination station has the advantage that it can offer steam-heating service to the owner of an isolated plant when an effort is being made to solicit his electrical load. In many instances, said Mr. Yeomans, this point has been important in enabling solicitors to close contracts shutting down isolated plants.

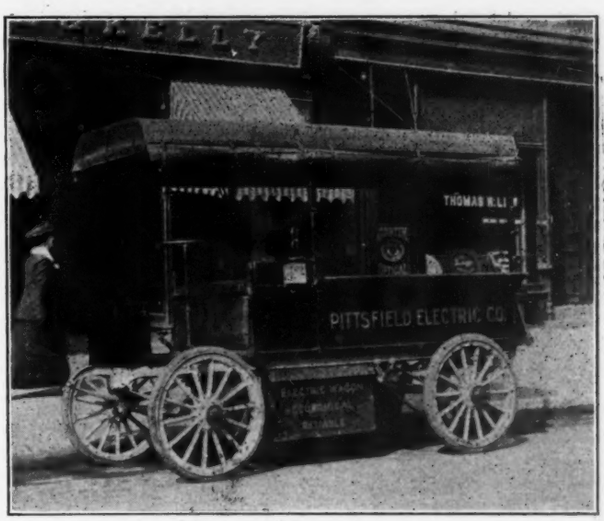
At present there is no set rule governing charges for steam-heating service, but the price is controlled in many communities by the cost of coal. In some places rates per 1000 lb. of steam are based on a charge of 0.1 of the cost of 1 ton of coal, for it is estimated that the average isolated plant will evaporate about 5 lb. of water per pound of coal. But the rates from this charge would heat the customer's building for practically the cost of his fuel bill, and in addition he would receive all of the benefits derived from the central-station service. In view of this fact, the author thought that rates based on such a charge were too low.

DATA FROM DAILY REPORT

General Data.	
Average temperature in deg. Fahr. for November	43
Electrical output in kw-hr	159,630
Water evaporated in lb	19,289,000
Steam sold in lb	10,772,000
Cost Data	
1161.76 tons of coal at $2.14	$2,486.16
Labor cost at plant	1,032.62
Superintendence and maintenance	168.64
Total cost of operation	$3,687.42
Receipts from steam sold	4,847.65
Balance	$1,160.23

Advertising on the Battery Box

Not a few of the central stations and merchants using electrical vehicles have already appreciated the merits of the battery box as an advertising display space, although in many instances the inscription consists merely of the words "Electric Wagon." The Pittsfield (Mass.) Electric Company has lately taken up the electric-vehicle cause with enthusiasm, and the accompanying photograph illustrates how by adding the words "Economical" and "Reliable" on the side of the battery box of one of the company delivery wagons the public is constantly reminded of these two most important attributes of the electric automobile. The cost of thus emphasizing the advantages of the electric machine is probably less than 25 cents a year. While there is nothing unique about this method of advertising it is so often neglected as to warrant mention at this time.



THE BATTERY BOX AS ADVERTISING SPACE

Illumination and Wiring

Battery-Room Wiring of Electric-Vehicle Factory

By T. W. Poppe

By building an extension equal in size to the former battery room, which was of quite recent construction, having been completed in 1911, the General Vehicle Company, Long Island City, has recently increased its floor area twofold. The electrical equipment was also doubled. Two

FIG. 1—SWITCHBOARD FOR CONTROLLING CHARGING OUTLETS IN THE BATTERY-FORMING ROOM

45-kw motor-generator sets were installed to supply direct current at 110 volts to the busbars of the switchboard in the battery-forming and charging room. The main switchboard, containing the controlling apparatus for the motor-generator sets, is illustrated in Fig. 3. This view also partly shows one of the motor-generator sets. At the right are to be seen six rheostats constructed as one unit, each rheostat being controlled by one of the single-pole circuit-

FIG. 2—BATTERY-FORMING ROOM

breakers on the bottom of the first panel. Directly over each circuit-breaker is provided a receptacle containing a lamp connected to its own individual circuit, so that when the energy is desired at an outside point the lamp is lighted automatically. This panel and the rheostats are used to recharge the batteries of all vehicles after they receive the several severe tests to which they are subjected before delivery to the customer. As will be seen in Fig. 3, each circuit is numbered on the panel. The charging receptacles controlled by these rheostats are placed at convenient points throughout the main floor and are numbered in a corresponding manner, so that as soon as one of the lamps is lighted the switchboard attendant knows that a battery is waiting to be charged and knows at what point it is located. The second and third panels contain the switches and compensators controlling the induction motors of the motor-generator sets. The bodies of the compensators are mounted on the rear of the panels and the operating handles on the front. The motor-generator set in the foreground is shown in operation, the compensator handle being on the running position, as shown in the second panel. Panels Nos. 4 and 5 contain the generator control apparatus. These panels are of standard construction, each supporting a double-pole switch for the negative and equalizing leads and a circuit-breaker in the positive lead, in addition to an ammeter and a voltmeter receptacle. Panel No. 6 carries two watt-hour meters used for checking the consumption of energy in the battery-forming room and the charging of vehicles in the factory.

Panel No. 7 is the feeder panel controlling two sets of

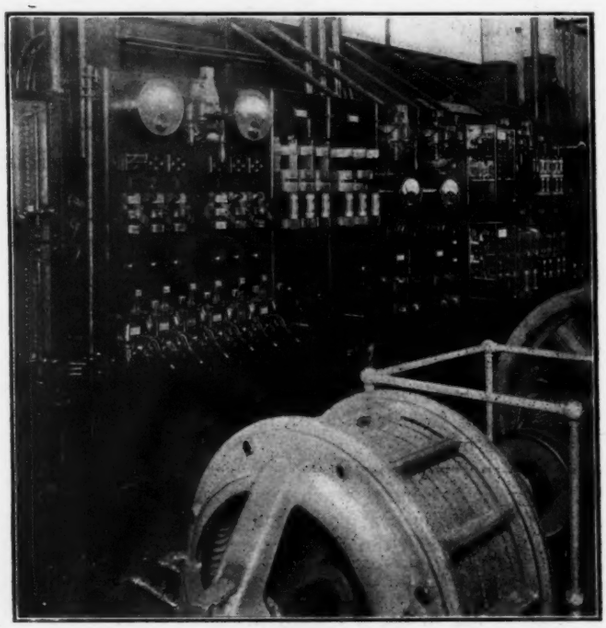
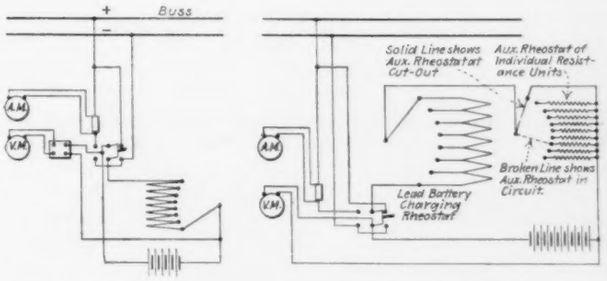


FIG. 3—MAIN SWITCHBOARD

500,000-circ. mil cables which transmit energy to the battery-room switchboard. Panels 8 and 9 are used exclusively for the charging of nickel-iron batteries.

Fig. 1 shows the rheostats, switches and instruments on the switchboard for controlling the various charging outlets in the battery-forming room. Some of these are shown in Fig. 2. There are eighty-four of these 150-amp receptacles, six of which are for nickel-iron batteries. The meters in the background are used for measuring the potential at the individual battery terminals and the current into each battery as it is being charged. The individual charging circuits are wired as shown in Fig. 4. By throwing the double-pole double-throw switch to the left the ammeter is placed in circuit with the rheostat and battery. The rheostat is then adjusted to the proper current value. When the switch is thrown to the right the battery is placed across the busbars in series with the rheostat. This arrangement permits the use of one ammeter with an almost infinite number of circuits. The voltage of the battery can be ascertained at any time by placing a plug in the receptacle provided for each circuit and shown at the left of each switch in Fig. 1.

The panel to the extreme left in Fig. 1 is used for charging nickel-iron batteries. Over this panel are mounted six rheostats constructed to form one unit. Each rheostat has a range of from 60 amp to 200 amp. At the upper end of the pole held by the attendant in Fig. 1 is a rheostat connected in series with one of the resistors used for charging lead batteries. This rheostat has individual resistance units at each contact and is used for charging batteries containing a smaller number of cells than the



FIGS. 4 AND 5—DIAGRAM OF INDIVIDUAL CHARGING CIRCUITS AND DIAGRAM OF CONNECTIONS FOR RHEOSTATS

standard battery. Fig. 5 is a diagram of the connections.

In wiring from this switchboard to the receptacles in the battery room exposed wiring is installed, since it was feared that the acid fumes from the batteries would have a detrimental effect on conduit. As shown in Fig. 8, the compartment containing the switchboard is 30 ft. long. The length of the switchboard, which is 27 ft., determined the horizontal distance in which wires could be taken through the wall. The minimum spacing for wires according to the rules of the Board of Fire Underwriters and the Department of Water Supply, Gas and Electricity is 2.5 in. Having eighty-four two-wire circuits on 168 individual wires to install at this spacing, a horizontal distance of 35 ft. was necessary. Thus, in order to confine these wires to a smaller space, it was decided to run 2-in. conduit through the brick wall in the rear of the switchboard and provide conduit fittings with porcelain covers containing holes to provide for six wires. Through these separate conduits six

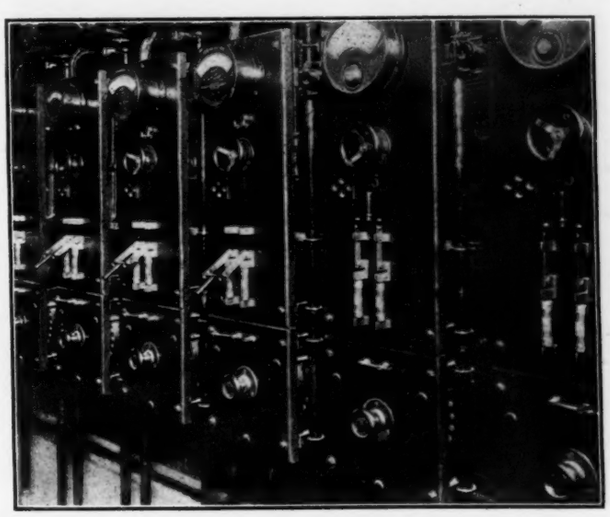


FIG. 6—SWITCH PANELS FOR DISCHARGING BATTERIES

wires were drawn. From the conduit fittings in the switchboard compartment to the rheostats and individual switches the wires are separately wrapped throughout their entire length with marlin cord and are treated with several coats of fireproof paint or compound. The marlin wrapping adds insulation and protection to the wires and was chosen because of its flexibility and neat appearance.

On the battery-room side of the wall wires of one polarity are carried from the conduit fittings upward over the top of a hanger constructed of wood. The wires of the opposite polarity are taken downward and fastened to the bottom of the support. As this wooden beam is 5 in. thick, it separates the wires of opposite polarity 7 in. when they are fastened in the insulators, the insulators being of a type

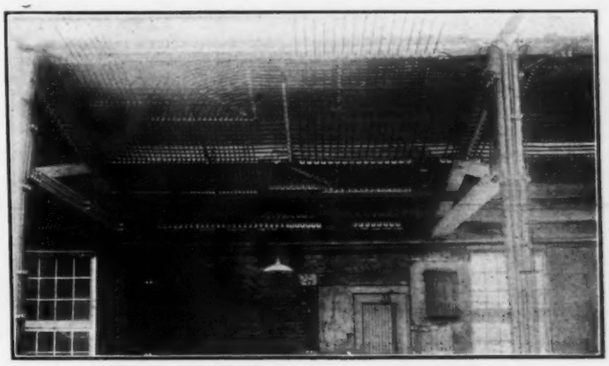


FIG. 7—KNOB AND CLEAT CONSTRUCTION

that holds the wires 1 in. from the surface of the support. All wires of the same polarity are separated by 3 in. to preserve a neat appearance. In Fig. 7 are shown the wires as they emerge from the wall through the conduit fittings and pass over and under the wooden hanger. The castings of the conduit fittings are set flush with the brickwork, leaving only the porcelain covers projecting into the battery room. This precaution was taken to protect the iron of the fittings from the action of the acid fumes.

The circuits are distributed in such a manner that no crossing of wires is necessary. Fig. 8 shows the locations of the various receptacles and the manner in which the circuits are installed to obtain the above result. Fig. 11 shows the manner in which the circuits are brought down the columns and the method employed to maintain clearance between the charging circuits and the discharge circuits. The receptacles shown in the various photographs were chosen because of their rugged construction and their current-carrying capacity and because the contacts where the wires are attached could be protected from acid fumes

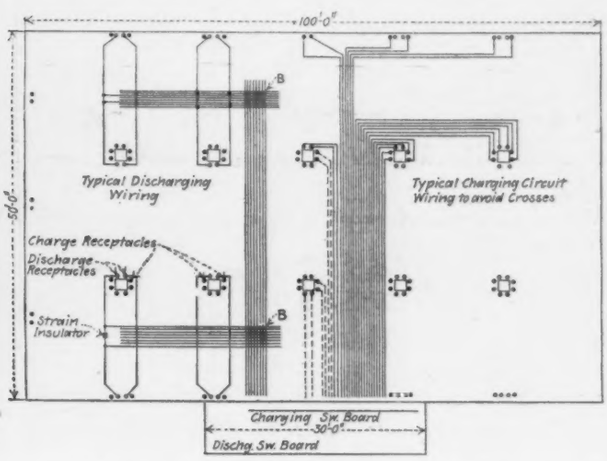


FIG. 8—COMPOSITE WIRING LAYOUT, BATTERY ROOM

by filling the cavity formation around the contacts with acid-resisting compound. The inspection departments having jurisdiction insisted that no contacts be exposed to the action of acid fumes.

In Fig. 6 are shown panels, containing the switches and rheostats necessary to discharge batteries at rates of more than 5 amp. The lower handwheel controls a rheostat

having twenty contacts with a total resistance of 18 ohms. This rheostat is used to discharge batteries at the rate of from 5 amp to 15 amp. The handwheel directly under the ammeter controls a rheostat of 6.4 ohms resistance, used to discharge batteries at the rate of from 15 amp to 60 amp. The construction of the rheostat is such that the next higher current value following 50 amp is 60 amp. As a

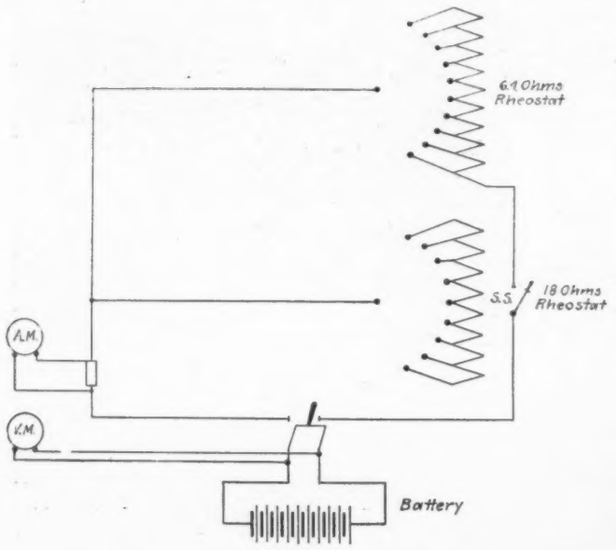


FIG. 9—DIAGRAM OF CONNECTIONS OF RHEOSTATS

53.5-amp value is sometimes desired for a discharge, the two rheostats are connected as shown in Fig. 9. By this means, when it is desired to use the higher resistance rheostat only, the single-pole switch shown in Fig. 6, directly over the lower handwheel, is opened. When the other rheostat is used this switch is closed, which places the two rheostats in multiple. Thus the desired discharge is acquired, together with a very fine adjustment of current values. From these eight panels cables are carried through the wall in a manner similar to that described above. The

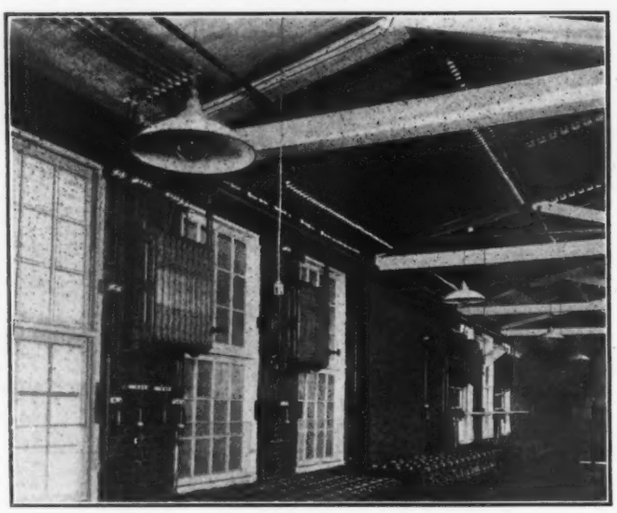


FIG. 10—250-WATT LAMPS USED TO ILLUMINATE BUILDING

circuits are carried directly across the battery-room ceiling, as shown in Figs. 2 and 7. Each of these eight circuits has four receptacle outlets.

In order to avoid any contact of the discharging circuits with the charging circuits, the discharge wires are strung lengthwise of the building under the upper beam of the roof truss and connected to the wires from the panels and the receptacles, which both run parallel with the end of the building and at right angles with the wires mentioned above. Where wires cross at right angles connections are made with short pieces of cable, as they are separated vertically by the thickness of the roof truss. These connections or jumpers are shown in Figs. 7 and 8. Because of the large number of charging circuit wires on the ceiling it was necessary to install the discharge circuits so that none of the wires would be actually attached to the ceiling. Fig. 11 shows a discharge circuit which continues down the column to two receptacles. The two central receptacles under the radiator in Fig. 11 are also discharge-circuit outlets. By tracing the discharge circuit on the right of the column in this illustration a strain insulator will be seen in the circuit. The connections made to wires going to the left give two distinct discharge circuits, and while they are electrically separated by the insulator, the cables are supported by the porcelain cleat insulators on the beams. This arrangement permits the discharge cables to be installed without providing a ceiling support where the connections are made. The value of this method can be appreciated by tracing the

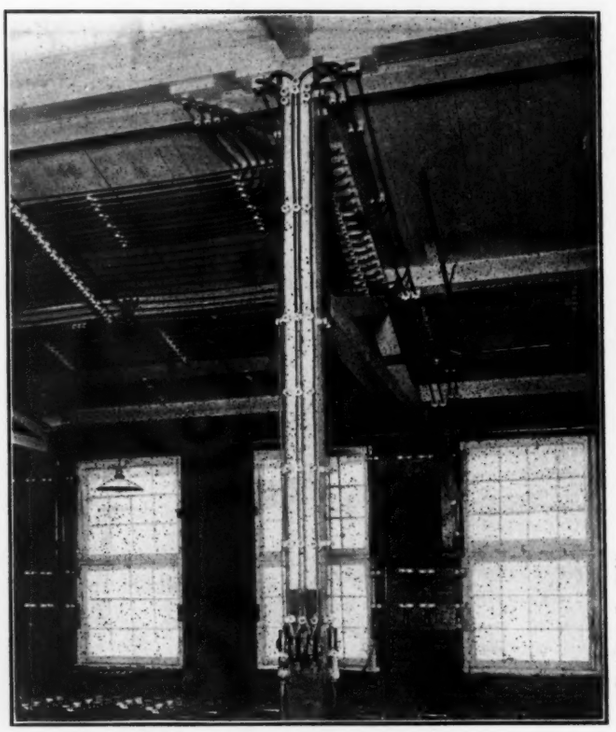


FIG. 11—CIRCUITS ON UPRIGHT COLUMNS

cables on the column in Fig. 11 and noting the large number of wires fastened to the ceiling at this point.

The arrangement of the wires going down the left and right sides of the column in Fig. 11 represents a typical method of installing charging wires at these points and shows clearly the space between the charging-circuit and discharging-circuit wires. At the middle of each bay angle-iron hangers are fastened to the roof beams and insulators attached to them to support the discharge circuits at these points. The absence of non-metallic flexible conduit and porcelain tubes is noticeable, but as there are no wires crossing one another at a spacing less than 3 in., additional insulation is unnecessary.

In wiring this building 24,000 ft. of No. 4 and No. 0 cable was used. As the building measures 50 ft. by 100 ft., it will be evident that 24,000 ft. of wire was installed in 5000 sq. ft. of space. Should this 5000 sq. ft. be laid out as a strip 1 ft. wide, four wires 2.5 in. apart, as required by the rules of the inspection departments, could be placed side by side over the full 5000 ft. and there would still be 4000

ft. of cable left over. The installation of this large amount of wire in a comparatively small space was made possible by arranging wires of one polarity at a higher point than the wires of the opposite polarity and placing the discharge-circuit wires under all. In fastening cleats and knobs square-headed lag screws were driven into the woodwork. No slotted screws were used. As 6600 lag screws were employed, it was necessary to devise a means of installing them in a quick and easy manner. This feat was accomplished by furnishing socket wrenches to fit the lag screws with square shanks to allow them to be used with carpenter's braces. A blow from a hammer on the head of the lag screw started it and the socket wrench in the brace allowed the workman to screw it home rapidly. During the installation of the wiring the charging and discharging of batteries was not interrupted. For lighting the building 250-watt lamps in steel-enameled reflectors, as shown in Fig. 10, are used. These lamps are wired three across the building in every bay, each bay being controlled by the porcelain pendent switches shown in Fig. 10.

Letter to the Editors

Rates for Electricity

To the Editors of the Electrical World:

SIRS:—The subject of rates for public utilities is in a state of chaos. One of the New York Public Service Commissioners says: "One fact stands out clearly in so far as rates for electricity are concerned, viz., they have no scientific basis." Rate systems vary from the easy, simple flat-rate systems of the gas companies, where all gas is charged at a fixed rate per 1000 cu. ft. regardless of all other considerations, to the elaborate sliding-scale and multiple-rate systems of the electric companies, requiring (speaking literally and without the least exaggeration) a chart and a slide rule for the computation of a bill.

Hardly two electric companies have the same schedule, and companies as closely associated as the Edison companies of New York and Brooklyn have different bases from which to figure their rates, with the result that a consumer in one borough pays twice as much for the same quantity of electricity as in the other borough of the city.

The difference between the highest and lowest rates are almost incredible and are met in the sale of no other public utility. In some localities the retail rate paid by occupants of small stores, workshops or residences is eight times the rate paid by the consumer of large quantities, and ratios of six to one are quite frequent. In some localities carbon and tungsten incandescent lamps are supplied free; in others only carbon lamps are furnished, and in still others no free renewals are made.

Some companies do wiring work, lend motors, and lend and care for arc lamps, taking their pay from the rate charged for electricity, while others perform one or more of these functions. In one town a fixed monthly charge is made for each meter connected, while in the next town no such charge is made. Some companies make a flat rate per lamp connected in signs and residences, and companies whose main business is the supply of energy for mills make a flat rate based on the number of horse-power of motors or on the greatest use at any one time.

No attempt has apparently been made to determine the cost of supplying different classes of service and, generally speaking, rate-making has resolved itself into each company getting all the business it can, without knowledge of whether it is really profitable or not, and charging for the service what the competitive conditions or legislative regulation will allow it to charge.

Such a condition leads inevitably to unfair discrimination between consumers costing substantially the same to supply, and it causes the companies, in their desire to increase gross receipts regardless of investment charges, to take on quantities of large business at or below the real cost of manufacturing and delivering the energy.

Some of the more enlightened managers of electric companies are realizing this condition, and many of the technical magazines recognized as representative of the central-station industry have published editorials pleading for fairer treatment of the small consumers.

Some rates (such as those of the New York Edison Company) are based solely on the quantity of electricity purchased by a consumer, while other companies (such as the Chicago and the Brooklyn Edison companies) base their charges to some large classes of consumers on the greatest demand by such consumer for any twenty-minute period, the rate in these cases being modified by discounts based on the quantity used.

The injustice of quantitative discounts is strikingly shown by the condition which has developed in New York city, where landlords and even outside companies purchase all the electricity used in a building in bulk, so to speak, and retail it to the tenants; and, more than this, owners of several buildings combine to purchase through one of their number and obtain additional discounts by so doing, running as high as 40 per cent, without any change in the cost to the company supplying them except the item of rendering one bill instead of three or four.

In a system of rates where larger discounts are given for quantity the result is necessarily to favor the rich at the expense of the poor, to add to the handicap of the manufacturer or storekeeper, in a small way, in attempting to compete with the larger manufacturer or storekeeper, and this is contrary to the spirit of the time, which, if it mean anything, means equal opportunity to the less favored in their struggle with the more fortunate.

It will be urged that this difference in rates is only the usual advantage a purchaser at wholesale has over a purchaser at retail, and this brings up the point at issue. On what basis shall rates for electricity be based? Here is the parting of the ways.

The electric company says: "Our rates should be such as will bring us the maximum of business, as in the end this will result in the lowest price to the consumer." The enlightened consumer says: "No; your rates must be based upon equal treatment to each of us. You must exact no more profit from any one class of consumers than from any other class. Our payments for electricity, while it is true they are made to a private corporation, are in the nature of a tax, and no group of citizens merely because it is powerful is to be favored."

The electric company rejoins: "If we are not allowed to make very low rates to consumers of large quantities of electricity, they will manufacture it for themselves, and it is only by increasing our gross sales that we can reduce our average cost and, in time, our average selling price."

This appears to be reasonable and sound, because it is a matter of general knowledge that doubling the gross output of a business seldom results in doubling the expense, and as a matter of fact it would be sound if the reduction necessary to obtain the large consumers' business was a small proportion of the selling price or, in fact, if the selling price was sufficient to cover the increase in operating expenses necessary to supply the large consumer with the interest and amortization charges on the necessary investment and a reasonable part of the overhead expenses and profit.

As all these items of expense will be found by a careful investigator to be nearly the same *per unit sold*, whether the consumer be large or small, it becomes equally apparent *that there could be possible no great difference in the selling price to large or small consumers unless the selling price to small consumers was excessively high.*

A great deal of testimony has been given before the

various public service commissions on these points, and in the case of Ewoldt against the New York Edison Company, before the Public Service Commission of the First District, New York, the testimony showed clearly that the only difference in cost due to wholesale or retail quantities was in the very minor items of metering, billing and collecting and lamp renewals, the whole difference between the groups of largest and smallest consumers being less than 1 cent for each kilowatt-hour sold, whereas the testimony showed that in order to obtain the large business a difference in rate of over 7 cents was made, or 700 per cent of the difference in cost.

Along these lines, the opinion of Louis D. Brandeis, the Boston lawyer, known particularly for his handling of the freight rate cases and the New Haven railroad matter, is particularly interesting. This opinion was given to a few manufacturers of apparatus used in private power plants who wished to obtain legal advice before forming an association to defend what they considered to be their rights and protect their business, which is vitally affected by the cut-rate competition of the central electric stations. The following extracts are from this opinion, the italics being the present writer's:

"In the past the common commercial view of selling cheaper in large lots prevailed to some extent in the public services; but the tendency toward equality of treatment of all customers has grown ever stronger. Indeed, even in progressive private businesses, particularly those operating under patents, copyrights or trademarks, the need of treating all customers alike, regardless of the quantity of their purchases, is becoming widely recognized. It seems clear that the tendency in our public service commissions and our courts must be toward an ever stricter enforcement of the rules against discrimination. I am therefore of opinion:

"First—Assuming that the cost of producing and delivering electric energy is the same per unit (kilowatt) regardless of quantity supplied, and in the absence of any statute regulating or limiting the price at which it may be sold, a public service corporation *cannot legally charge a lower rate for a larger (wholesale) than for a smaller (retail) quantity delivered at the same time and under similar conditions.*

"Second—Assuming that the cost of producing and delivering electric energy is the same per unit (kilowatt) regardless of quantity supplied, and in the absence of any statute regulating or limiting the price at which it may be sold, a public service corporation cannot charge A 10 cents per kw for 200 kw per month and B 2 cents per kw for 20,000 kw per month, delivered at the same time and otherwise under similar conditions, assuming that the entire cost of service to each is 4 cents per kw.

"Third—*Assuming that there is a difference* between the cost of making, delivering and selling electric energy between the wholesale and retail consumer, a public service corporation can, in the absence of any statute regulating or limiting the price at which it shall be sold, make a higher price to the retail customer, *but the difference in the selling price may not be substantially greater than the difference in cost.*

"Fourth—As to the right of a public service corporation to make a substantial difference in its charges based upon the broad purpose for which it is used, namely, a difference between light and power, there is more doubt. Some decisions in the state courts would seem to justify such discrimination, but the great weight of authority as well as of reason seems opposed to permitting *any discrimination based upon the use* to which the electric energy is put, and therefore upon the facts assumed in the question such discrimination between charges for electric energy used for power and charges for electric energy used for light should be held illegal.

"On the other hand, the difference between day use, when the demand upon the station is small, and evening use, when the demand upon the station is large, seems a proper basis of classification of service, and a court might for this reason upon the facts disclosed in a particular case hold that use for power, as calling mainly for day use, fell within a different class of service from use of light.

"It seems clear, however, that mere difference in the value of the service or its character to the user does not afford any justification for discrimination as to rates."

It will be seen that Mr. Brandeis takes a broad stand for equal rates regardless of quantity, and he further lays down the maxim that no greater difference in rates is justified between any classes of consumers than the reasonable difference in the cost of supplying them.

Here, then, is a logical and fair basis for rate making: *Determine the cost of supplying as nearly as can be any group or class of consumers, and fix the rate for this class at a reasonable profit above this cost.* While a single flat rate, similar to the rates for gas and water, would be ideally simple, it appears to be true that for the complete development of the use of electricity different rates for different services are essential, and if such differences are based upon the cost of supply there would seem to be no valid objection to their use.

The schedules should be easily understood by every purchaser of electricity, and for the multiplicity of rates and schedules should be substituted a very few. The greater necessity for difference in rates in the sale of electricity than in the sale of gas or water arises mainly from the inability to store sufficient electricity for any large, long-continued demand. The effect of this lack of storage capacity has been tremendously and wilfully exaggerated. The lack of storage capacity can affect materially, in a large system, only the fixed charges on the power plant and substations, and the fixed charge on the whole amount of such investment does not usually amount to 1 cent for each kilowatt-hour sold.

There would seem, however, to be a justifiable difference in rate between a consumer using electricity twenty-four hours a day seven days a week and one using it one hour a day, because the fixed charges in one case are apportioned among 8760 hours, whereas in the second case they are apportioned among 365 hours. A consumer who uses electricity mainly for lighting and whose greatest use coincides with the greatest demand on the electric company's whole system costs the company much more to supply than the consumer who uses electricity mainly for power and shuts down his shop before the heaviest load on the whole electric system comes on. This difference is the foundation of many different schedules, having for their basis the "maximum demand" of a consumer, which will be discussed later on.

The unfairness of the quantitative discount is most clearly evident in this latter example, because with the quantitative system the large consumer of light obtains a rate from two to three times *lower* than the small consumer for power, although the cost to the company of supplying the latter would be less than the cost of supplying the former.

A consumer who could arrange to use electricity from midnight until eight in the morning would cost the electric company very little more than the cost of fuel and similar materials needed for its supply, and would aid in improving the efficiency of operation by building up the load of that light-load period; hence a low rate given for such period would be justified, as it would aid in reducing the average cost per kilowatt-hour sold. Similarly, to consumers using electricity for driving compressors of refrigerating plants, for vehicle charging, for electroplating or for hoisting a lower rate might be given to encourage development, provided the hours in which the electricity was used did not coincide with the heaviest load on the system.

There does not, however, appear to be any justification for any greater difference in rate to a group of fifty apart-

ments than to a single apartment except the difference in the cost of billing and collecting, nor between a group of businesses combined as a department store and a single store of similar character. That the tenants of a building or the owners of a number of buildings adjoining combine their purchases offers no reasonable basis for a difference of from 30 to 40 per cent in the price, nor should a large hotel receive a materially lower rate than a small one, because the cost to the company for each unit quantity supplied is substantially the same in each case.

The schedules of rates based on quantity have, therefore, it would appear, no valid foundation, and their result is discrimination between consumers clearly entitled to equal treatment.

As has been noted, another group of schedules has for its basis the maximum demand of an individual consumer. In this class of rates the use by a consumer is recorded continuously and the greatest quantity used by him at any moment—or more usually for any twenty-minute period—is made the basis of the rate. The usual method is to charge the maximum rate for an average use of one hour a day of this maximum demand, a rate half as great for a second hour's use, and all the balance is charged at a low rate and, unfortunately, even with this schedule additional discounts are given for quantity.

The theoretical basis of this group of rates is that the company's investment will be proportional to the consumer's maximum demand, and the high rate charged for first and second hours' use of such a demand is intended to pay fixed charges as well as operating costs and profits, leaving the other hours to carry operating costs and profits only. This method, while apparently fairly based, is almost as unreasonable as the schedules based on quantity solely. The maximum demand of an individual consumer has but little bearing on the company's investment unless this maximum demand coincides with the maximum demand on the system. The maximum demand on all large electric lighting systems occurs between 5 and 6 o'clock in the evening in December and January. The power plant capacity is fixed by the demand at this period; hence, any maxima of consumers which occur before 4 or after 6 o'clock in these months do not add to the power plant cost, and the same is true of maxima occurring during other periods. It is the sum of the demands between 4 and 6 o'clock in this period, whether they are the consumers' average or maximum demands, which determines the company's investment, and if any such basis were to be used the demand of the consumer during this period should be the basis. Even this would be unfair, because of what is known as the diversity factor, and as this is most important in any rate discussion its meaning should be made perfectly clear.

In a group of fifty or a hundred apartments, on one night three or four may have most of their lights lit on account of entertaining guests, half a dozen may be practically dark, and in the rest not one-fifth of the lights will be in use. The next night approximately the same proportion will exist, but the three or four apartments using most of their lights will be different ones. The same thing is true, but to a much smaller degree, in offices, hotels and factories. The busy season of one factory may be the slack season of the other.

It is evident that any schedule based on the maximum demand of each apartment user would be unfair because the maximum demand on the central station is the demand of the group as a whole, not the demand of the individual. This averaging of demand is at the root of the central-station industry, as it is because of this that capacity in central stations is installed only equal to a fraction of the greatest theoretically possible demand.

The diversity factor is the proportion that the greatest demand of a group bears to the sum of the individual greatest demands. In the group of apartments cited the sum of the greatest demands of the individual apartments, if there were a hundred of them, might be 4000 lights, but the actual maximum demand would not be over 800 lights. In a group of stores, if the sum of the individual maximum demands was 4000 lights, the maximum demand of the group would be perhaps 2800 lights. Several most careful investigations have been carried on to determine the diversity factor in each class of users and tables have been published giving the results of such investigations, so that the matter is one of practical knowledge and not speculation.

It becomes evident at once that any schedule of rates based on the individual maximum demand that did not take into account the diversity factor would be to the highest degree unjust and discriminatory, and even if the diversity factor were considered, unless the time of day and period of the year were also factors, the schedule would not be based on cost of service.

It would seem that the only fair basis for a rate would be one predicated on the time during which the energy was used, but this would involve two-rate meters with clock-work, and such a method would not be possible except for consumers of large quantities, where the cost of meters would be insignificant compared to sales. The other alternative would seem to be to have the Public Service Commission fix rates for various classes of consumers, based upon hours of use, diversity factor and cost of metering and billing.

A year's investigation by the installation of a few hundred maximum demand meters would enable any public service commission, through its engineers, to fix the probable periods of maximum demand for different types of consumers, and with these records as a basis differential flat rates could be established which would represent average cost plus average profit for each class.

From the writer's own investigations, he is convinced that the present rates will be found to be entirely wrong, as many of the consumers receiving the lowest rates cost more to supply than those paying the highest prices. This conclusion is based upon a great many load curves collected from buildings of all types during more than fifteen years, supplemented by direct personal knowledge of conditions, and this knowledge also leads to the conclusion that perhaps the greatest beneficiaries of the change in rates would be the companies themselves. At present these companies are supplying current to a number of consumers of large quantities at cost or less than cost, if fixed charges are included, as, of course, they should be.

They are obliged to supply a very large demand during the mid-winter, which lasts only an hour or so during comparatively few days, so a large investment is needed, which is used only a few hours during a year, and this investment is mainly needed to supply the consumers receiving the lowest rates. Under a logical rate system, a much lower rate would be given to consumers of small quantities, and the writer is satisfied—although it is directly contrary to the usual belief—that the small stores' and apartment dwellers' rate would be greatly reduced, as they are now bearing an undue share of the cost and profits of the companies. A lower rate to such consumers would greatly stimulate use, and any loss the companies might sustain through the large consumers starting to manufacture their own electricity would be far more than compensated by the increase in use by the small consumers, and as the loss through the large consumers would be sales at very *low* rates, and the gains would be sales at *high* rates, the probable benefit to the companies is obvious.

New York, N. Y. Percival Robert Moses.

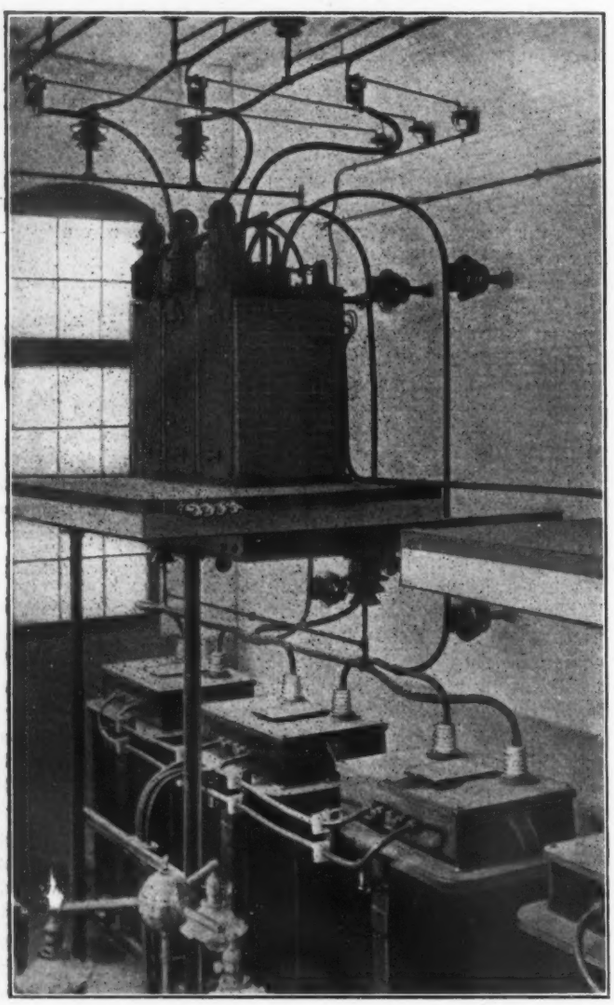
[The general subject of rate variation, as suggested by the opinion of Mr. Brandeis, is discussed in an editorial in this issue. The fundamental fact should be borne in mind that differences in rates, where the conditions of service differ, do not constitute discrimination.—Eds.]

Field of the Operating Engineer

A Record of Practice, Experience, New Ideas and Interesting Problems—Notes on Practical Subjects—Questions and Answers

Platform Support for Oil Switches

The accompanying illustration shows an effective method of installing solenoid-type oil switches in a New England substation originally designed for 22,000-volt service. On account of an increase in the transmission pressure to 33,000 volts, the rearrangement of wiring in the substation constituted something of a problem when the change was made. All of the available floor space was occupied by two banks of transformers and two rotary converters, with the controlling switchboard. The engineers in charge of the work therefore designed a reinforced-concrete platform above each bank of transformers for the corresponding oil-switch



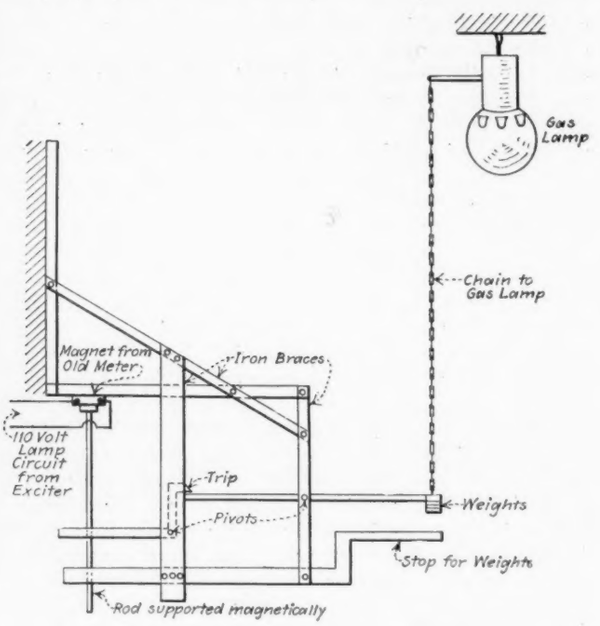
REINFORCED-CONCRETE PLATFORM FOR OIL SWITCHES

installation. These platforms are each 9 ft. long, 8 ft. 6 in. wide, and 7 in. thick from the top to the bottom of the slab, the reinforcing bars being of ⅝-in. stock placed laterally and longitudinally 9 in. apart on centers. Each platform is provided with a curb made of 2.5-in. by 2.5-in. by 0.1875-in. angle-irons, and at the outer edge the slab is carried on a 5-in., 9.75-lb. I-beam supported by 4-in. wrought-iron pipes. Cross I-beams are run from the front of each platform into the wall at the rear, which provides a bearing surface for the beams. The illustrated arrangement of switches enabled the wiring to be brought into the substation overhead with ample clearance for safe operation and straightforward travel from the roof bushings to the transformers. The overload-trip coils in the high-tension leads are located close to the ceiling above the switches, the relays being actuated by horizontal rods run to them, as shown. The circuit-closing contacts are mounted in a bank against the wall and connected with the solenoids of the switches by circuits run in conduit.

Automatic Control of Emergency Lamp

In central stations where motor-driven exciters are used it is often considered good policy to have at hand some source of auxiliary illumination to be used in case of failure of the exciter set. In the plant of the Marion (Ind.) Light & Heating Company, which is operated in parallel with the Muncie (Ind.) station, an ingenious arrangement has been worked out providing this emergency lighting at low cost. The method used is outlined in the accompanying sketch.

An old meter magnet is mounted on an iron frame and connected to a lamp circuit which is energized from the exciter. When the voltage across this magnet is reduced



AUTOMATIC GAS-LAMP LIGHTER FOR BREAK-DOWN SERVICE

the suspended rod is dropped. The flange of the falling rod strikes the lever end of the trip and releases a weighted bar connected to the gas-lamp chain. The weights attached to this bar exert a pull which is just sufficient to trip the automatic lighter in the gas lamp. A stop for the weights has been provided so that the lamp will not be subjected to unnecessary jerks caused by the falling weights. By succes-

sive trials the weight of the falling rod has been adjusted until the magnet will operate when the exciter potential falls to 100 volts.

The station force claims that on account of the parallel operation of the station the device has proved to be invaluable. When the Muncie station drops a large portion of its load the exciter voltage at Marion is often lowered to a point which calls for attention. In cases of this kind the gas lamps never fail to give the alarm and trouble from this source is obviated.

Previous to the installation of this device the gas bill for one large lamp was about $10 per month, but now the monthly bill has been reduced to the minimum, as it is necessary to keep only the pilot flame alight.

Reduced Cost of Iron-Pipe Cross-Arm Construction

For several years the Marion (Ind.) Light & Heating Company has been using cross-arms made from iron pipe bought at junk yards and other places were second-hand pipe in fairly good condition was available. A single arm intended for use on straight lines where no dead ends

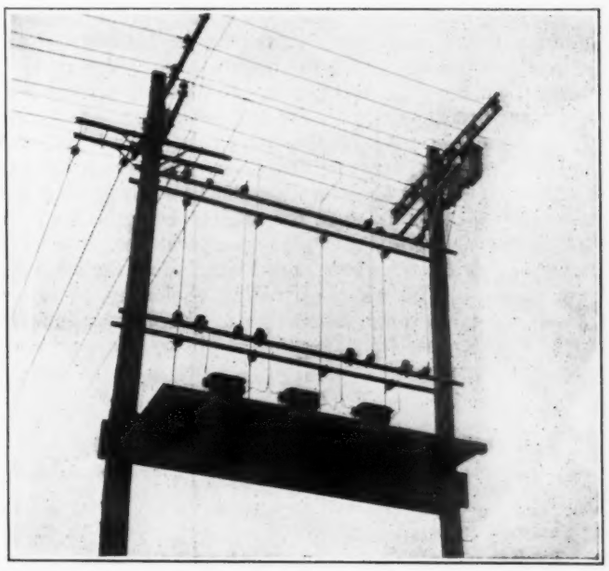


FIG. 1—IRON-PIPE CONSTRUCTION AT TRANSFORMER BANK, EATON, IND.

are to be placed is made of a 5-ft. piece of 2-in. pipe. Holes are bored in the pipe to accommodate a 0.625-in. through bolt at the center and 0.3125-in. carriage bolts for securing 26-in. braces at about 16 in. from the center of the arm. The pins on the single arms are made of cast iron and are held in place by common axle clips bought

COST OF A 5-FT. IRON-PIPE CROSS-ARM

Second-hand 2-in. pipe	$0.225
Blacksmith's charge for boring	0.045
Pins	0.050
Axle clips	0.025
Total	$0.345

from a local hardware store and formed to fit the 2-in. pipe. The accompanying table shows approximately the cost of a 5-ft. arm.

A type of pin not shown in the illustration has recently been worked up for use with pole-type transformer installations. The base of the pin casting fits over the end of the pipe and is held in position by means of a set screw. In this manner an extra horizontal pin which is very useful in supporting transformer taps is provided at the end of the arm.

Where wires are to be dead-ended use is made of a double-pipe arm, which carries the insulators on bolts between the two pipes as shown in the illustrations. Although these arms cost a trifle more than those made from a single pipe, no braces are needed with them, so that the total

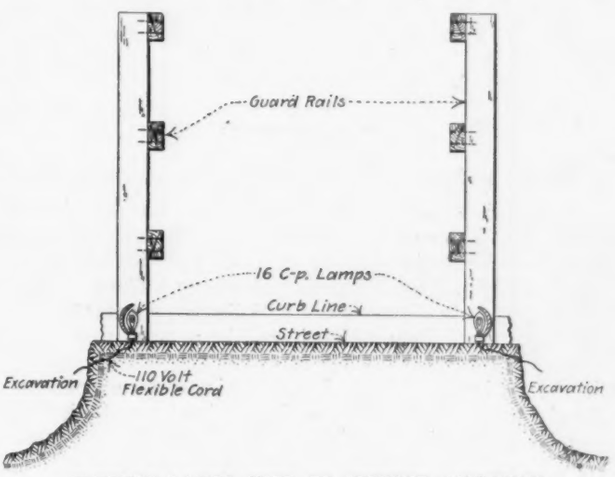
FIG. 2—STANDARD AND DEAD-END IRON-PIPE CROSS-ARMS

difference in price is very slight. Further saving is effected in framing poles to be fitted with iron-pipe cross-arms, for as a rule no gain is sawed in the pole, as is necessary with wooden arms. The through bolts draw the iron arms into the poles far enough so that sawed gains are not needed.

In general it is said that the pipe construction has proved so satisfactory that it is being employed wherever possible. As fast as the old wooden alley racks which formerly carried the Marion company's circuits in the downtown districts begin to show signs of weakness, they are being replaced with racks of iron-pipe construction. Heavier 3-in. pipe is used for this service. More durable and economical type of construction is produced by setting the ends of the 3-in. pipe in the brick walls of the adjoining buildings than by the use of hangers attached to the walls.

Electric Lamps as Accident Preventers

At a busy corner in New York City the crossing used by pedestrians was for a time partially blocked by a public-utility corporation while making underground repairs, thus narrowing the available path to about 3 ft. With a continual stream of hurrying shoppers crowding through this narrow passage there was danger of heedless persons

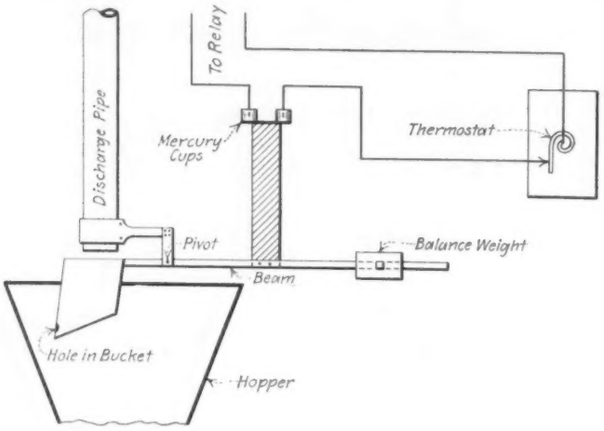


ELECTRIC LAMPS USED TO PREVENT ACCIDENTS

tripping on the curb, which stood about 6 in. above the level of the street. But the foreman of the construction crew foresaw the danger and materially reduced the risk by placing a 16-cp lamp at each side of the walk where it would shed its rays on the curb and yet would be out of the way of traffic. The accompanying sketch shows how the lamp was mounted.

Water Relay for Use on Transformer Piping

Each of the water-cooled transformers on the system of the Washington Water Power Company, Spokane, Wash., is equipped with a protective device which in case of interruption to the transformer water supply automatically trips out the high-tension oil switch and rings an alarm bell to call the station attendant. The device itself, which is



SCHEME OF WATER-RELAY CONNECTION

known as a "water relay," consists, as shown in the sketch, of a small water bucket and a movable iron weight fastened to opposite ends of a short beam. As long as the water is pouring from the discharge pipe into the small bucket and running over into the hopper beneath, the added weight of the water keeps the contacts at the mercury cups closed. But should the water supply fail the water in the bucket drains out through the hole in the bucket bottom, and the iron weight falls and breaks the contact. By experimenting with the size of the hole in the bucket a fairly accurate time element can be introduced if it is desired.

The thermostat shown in series with the alarm circuit is provided so that if the transformer becomes unduly heated from any cause the alarm will also be given and the oil switch tripped in time to save the transformer. The thermostat is made of a spiral of two dissimilar metals and is hung in the oil above the transformer windings. This device has been found valuable where the flow of water was only partially interrupted, allowing enough water to fall into the bucket to balance the beam.

New Condensing-Water Tunnels at Racine, Wis.

A new concrete intake and discharge tunnel which will replace an older one of smaller rating is just being completed at the Racine (Wis.) generating station of the Milwaukee Light, Heat & Traction Company. The new tunnel will be 3.5 ft. in diameter and will discharge water by gravity into a well from which it will be pumped through the condensers. Only 5500 kw in generating units is installed in the station at present, but an ultimate rating of 15,000 kw is contemplated, the condenser intake and discharge tunnels being laid out with this in view. The old tunnels which are being replaced by the newer construction were only 20 in. in diameter.

Additions have also been made in the boiler-room equipment, three 500-hp Edge Moor water-tube boilers with Jones stokers having been installed. A Terry-Platt turbine-driven centrifugal boiler-feed pump capable of delivering 200 gal. per minute has also been installed. Three turbine-driven fans are being installed and other changes are being made which will greatly increase the rating and improve the operating conditions of the plant.

Patching a Broken Switch Panel

In making some repairs a piece of a marble end panel was accidentally knocked off. Can the piece be put back without marring the appearance of the board? B. A. M.

Make a cement of four parts of gypsum and one part of powdered gum arabic mixed to a mortar-like mass with a cold solution of borax. Fasten the broken piece with this mixture and let it stand for a few days before touching it. The borax solution can be colored to match the marble and the joint waxed and polished.

Sulphur as a Cause of Clinkering

We are having trouble with clinkering and have been advised that this is due to sulphur in the coal we are using. Can one determine in advance, from analysis of its chemical impurities, whether a given fuel will clinker, and does the presence of sulphur invariably indicate tendency to clinker? K. S. M.

There is a general impression that sulphur is the cause of clinkers forming, but this view is now being amended owing to the fact that the trouble mentioned seems to depend more on the method of firing and the rate of combustion than upon the constituents of the ash. In fact, coals containing as much as 5 per cent of sulphur may be burned without any difficulty whatever due to clinkering. Sulphur, alumina, iron, silica, lime, etc., reduce the fusibility of ash, it is true, depending upon the quantities in which they are present, but the chief factor seems to be the frequency with which the fireman slices his fire and works up the ashes into the bed of hot coals. In the latter case the ash will melt and fuse together, forming dense, heavy masses of clinker. But this result may be quite independent of the presence of sulphur in the original coal, for sulphur, being both volatile and combustible at relatively low temperatures, would certainly be driven off and consumed long before the ash stage was reached. The way to avoiding clinkering, therefore, seems to be in proper instruction of the fireman, and we doubt whether one would be justified in relying on a mere chemical analysis.

Percentage of Unaccounted-for Output

In central-station practice what is considered a reasonable percentage of unaccounted-for output—in other words, the difference between the readings of the station watt-hour meters and the sum of the readings of customers' meters? W. E. L.

The unaccounted-for output of central-station systems varies widely and depends upon a number of factors, such as line resistance and conductor drop, efficiency and rating of transformers connected, character of meters installed, condition of lines, insulation of circuits, trimming of trees on right-of-way, presence of grounds in customers' premises, etc. In one extreme case of which we have record the total of kilowatt-hours consumed by the transformer iron losses during the daylight hours was practically double the consumption of the community by night, but this was a new industrial city which was expected to grow rapidly and had therefore been "over-transformed" with the expectation that it would soon reach up to the liberal rating provided. On the other hand, several other cases have been reported where the sum of the customers' readings actually equaled or even exceeded the registration of the station instruments, but here investigation showed that it was the meters that were acting badly. In the average well-kept alternating-current system the distribution losses or unaccounted-for kilowatt-hours will usually run from 10 to 30 per cent, with 15 per cent as a common figure. This is equivalent to a metered registration of 85 per cent of the plant output, which may be considered very fair practice. In direct-current distributing systems, however, the losses, owing to drop in conductors, are usually much greater. One large metropolitan company, for example, recently reported unmetered losses aggregating 40 per cent of its total output.

Digest of Current Electrical Literature

Abstracts of Important Original Articles Appearing in the Periodical Electrical Press of the World

Generators, Motors and Transformers

The "Hand" of an Armature.—Humphry MacCallum.—The author criticises the way in which the terms "right-handed" and "left-handed" are sometimes applied to armature windings. He recommends the following two definitions for the purpose of distinguishing between those armatures which under similar conditions give opposite directions of rotation: "Right-handed armatures are those in which the positive brushes are opposite the north poles of the field magnet when the direction of rotation is clockwise when viewed from the commutator end. Left-handed armatures are those in which the positive brushes are opposite the north poles of the field magnet when the direction of rotation is counter-clockwise when viewed from the commutator end." An important advantage of this method of classification is that it applies equally well to the series or the parallel armature. The essential difference between the two hands in either case is that in the "right-hand" coupling coil ends or the ends of a "round" cross one another, whereas in the "left-hand" coupling they do not cross, a distinction which gives rise to the following perfectly definite rules: (1) In all lap or parallel-wound drum armatures if the right ends of section cross one another, the winding is "right-handed," but if they do not cross it is "left-handed." (2) In all wave or series-wound drum armatures if the ends of a complete round, consisting of $p/2$ sections, cross one another, the winding is "right-handed" and if they do not cross it is "left-handed."—London *Elec. Review,* Sept. 19, 1913.

High-Frequency Alternators.—An illustrated review of recent developments in the use of sustained oscillations in wireless telegraphy and the design and uses of high-frequency alternators.—London *Elec. Review,* Sept. 12, 1913.

High-Frequency Alternator.—T. R. Lyle.—A highly mathematical paper read before Section A of the British association, in which the author shows that the theory of the Goldschmidt alternator is a simple case of the more general theory of the alternating-current generator which was published by the author in 1909.—London *Electrician,* Sept. 26, 1913.

Air Filter.—An illustrated description of air-filter plants of British make for the purification of the air used for cooling electric generators.—London *Elec. Review,* Sept. 26, 1913.

Lamps and Lighting

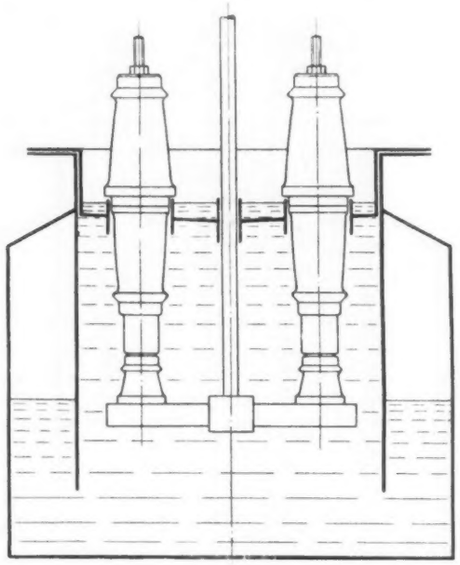
A New Method of Starting Mercury-Vapor Apparatus.—J. S. Anderson.—An abstract of a paper read before the British association. Mercury-vapor lamps and rectifiers are started by tilting the lamp or rectifier, either by hand or automatically. This is inconvenient, especially when dealing with lamps used for scientific purposes. For example, in carrying out experiments on the Zeeman effect a mercury-vapor arc lamp is extremely suitable. But difficulty arises from the fact that the lamp must be placed between the poles of an electromagnet, the distance between the poles being usually so small that any tilting apparatus interferes with the proper mounting of the lamp. This difficulty has been overcome by constructing a lamp which may be fixed in position between the poles of an electromagnet, or in any other suitable position, and then started without having to be tilted. This is brought about by the employment of a heating arrangement near one of the electrodes, preferably the negative electrode. The lamp tube is provided with a small vessel near this electrode, the vessel having a re-entrant portion or recess in which a heating element is placed, while the part of the tube immediately above this small vessel and its recess is constricted. The heating element consists of a small coil of platinum wire wound round a suitable support. It may be placed in the recess of the small vessel or removed at will, without interfering with the vacuum of the lamp. This heating coil of wire is connected in series or in shunt, in the latter case being provided with an automatic cut-out. An external resistance is placed in series with the lamp. Before starting, the small vessel is full of mercury, which forms a continuous connection inside the tube between the positive and negative electrodes. When the current is switched on the heating coil becomes incandescent, and the heat given off raises the temperature of the vessel and its contained mercury. Very little heat is required, because the first bubble of mercury vapor formed rises to the constricted portion of the lamp and is there caught, thus breaking the continuity of the mercury inside the lamp and starting the arc. The platinum wire of the heating element can be made of such a thickness, and the external resistance can be so adjusted, that the wire does not emit heat when the lamp is working but becomes incandescent when the lamp is started, the action being quite automatic.—London *Electrician,* Sept. 19, 1913.

Generation, Transmission and Distribution

Maximum Loads on Transmission Lines.—H. B. Dwight.—An article on the problem of the minimum transmission-line capacity which will serve to transmit a given block of power, or, in other words, what the limits are to the loading of a transmission line. Varying-voltage lines and constant-voltage lines are discussed and the following conclusions are reached: For transmission lines the line voltage is limited by the phenomenon of corona. The limit of the load on a line operated without synchronous condensers is variation in voltage. The load limit for a line operated at constant voltage by means of synchronous condensers is much larger than the above limit, and the limiting condition is usually low efficiency. For heavy lines, with large reactance, or where the cost of power for line losses is low, theoretical limit for constant-voltage lines may be approached, which will involve increased cost of synchronous condensers. The charging current is of small commercial importance, even though it may be large in amount, and must be carefully allowed for. In general, it is a help; its main disadvantage is that it increases the voltage rise when load is suddenly disconnected from systems not closely regulated.—*Elec. Journal,* September, 1913.

Power Transmission and Oil Switches.—An account of the very long discussion which followed the recent paper by Klingenberg before the German Association of Electrical Engineers on power transmission over extended districts. Leitgebel, Roessler, Klingenberg, Stern, Schwennicke, Goldenberg, Schueler, Kuebler, Georges, Peterson, Meyer, Wunder, Wikander, Weltzel and Seitz participated in the discussion. Roessler emphasized the fact that in

large transmission systems it is not always best to use one high transmission voltage and one low distribution voltage, for in certain cases economies will result if three voltages are used, including a medium pressure between the high potential for transmission and the low voltage for distribution. In spite of double transformation losses the total cost may be less, but each case must be figured out for itself. Stern spoke of explosions of oil switches. When the arc is formed oil is evaporated and this vapor mixed with air forms an explosive mixture. There can be no such explosion if the mixture of the oil gas with air is prevented. The oil switch cannot be made air-tight since the gas developed by the arc produces a pressure which the construction would not stand. The new oil switch of the Allgemeine Elektricitäts Gesellschaft serves to prevent



OIL-SWITCH CONSTRUCTION

mixture of the oil gas with air but retains the air cushion. The oil box has three chambers, the switch being in the central chamber, which is completely filled with oil. The air is above the oil in the two side chambers. There is evidently no possibility of the oil gas mixing with the air. Very small switches of this design have been successfully used to rupture short-circuits of turbines up to 18,000 kva. —*Elek. Zeit.*, Aug. 28, 1913.

Traction

British Municipal Tramways Association.—An account of the recent Sheffield conference of the (British) Municipal Tramways Association. The presidential address by A. R. Fearnley dealt with general conditions of municipal street railways and referred at some length to competition from motor omnibuses. The speaker declared it advisable for railway systems to make experiments with buses. Papers were presented by S. Flint on the advantages and disadvantages of platform fare collection, by W. C. Fenton on the maintenance of paving on street-railway track according to British law, and by J. B. Hamilton on city passenger transportation.—London *Electrician*, Oct. 3, 1913.

Motor Omnibus.—An editorial on the field of the motor omnibus with reference to the discussion at the (British) Municipal Tramways Association. In London and its suburbs street-railway companies are suffering heavily from motor-omnibus competition, and provincial companies are beginning to become apprehensive. The present position of railway enterprises in Great Britain is said to be unsatisfactory. Although large street-railway systems can pay satisfactorily, small ones do not often reach this happy position. The extension of lines into districts where the density of the traffic is low is liable to prove unremunerative. Nevertheless, passenger traffic should be provided as far as possible in outlying districts where the traffic is small if such districts are to be developed, and it then becomes a question what method should be adopted. One method is to use the trackless trolley car. This has the advantage that energy for the purpose can be obtained simply by the extension of the overhead system. The other method is to use motor omnibuses as feeders to the railway system. For this reason the motor omnibus should have careful consideration by street-railway managers, quite apart from its claims as a rival. At the Tramway Association conference J. B. Hamilton presented a paper which was antagonistic to the motor omnibus. He claimed that it can be worked only at a loss. On the other hand, E. R. Fearnley in his presidential address admitted that both the motor omnibus and the trackless trolley have certain advantages. There are possibilities of a reduction in the price of gasoline and in the future reduction of the consumption of gasoline per mile. Mr. Fearnley would "even consider the possibility of running motor omnibuses in preference to relaying the track. The Sheffield tramways committee has found it desirable to try the effect of running motor omnibuses in conjunction with its cars and has had ten omnibuses for this purpose on four routes. The vehicles have proved reliable; the traffic they have handled has been very heavy, and there seems to be no doubt that next summer a much larger number of such vehicles will be required to meet the demand."—London *Electrician*, Oct. 3, 1913.

Mountain Railway Locomotives.—E. Seefehlner and F. Popp.—An English translation of their recent German paper on the design of the locomotives for the Mittenwald Railway. The overhead trolley pressure is 15,000 volts and the frequency is 15 cycles. A single-repulsion motor is used on each locomotive, and has an hourly rating with natural cooling of 800 hp, developing a tractive effort of 7500 kg at the circumference of the wheels at a speed of 30 km (24 miles) per hour.—London *Electrician*, Sept. 26, 1913.

Installations, Systems and Appliances

Arcless Interruption of Circuits.—F. Kraus.—The author starts with the Ayrton formula for the electric arc and derives from it the conditions under which no arc is possible. He finds that either one of the following two conditions must be fulfilled: The first is that an arc will be impossible if the voltage is below a certain minimum. The second is that for a given voltage there is a certain minimum resistance for which an arc is impossible. If the circuit is broken with a current less than that corresponding to this critical resistance there will be no arc. The first condition is well known. The second does not seem to have been realized. The author discusses experimental investigations concerning the correctness of this second condition and describes practical applications of the principle.—*Elek. u. Masch.* (Vienna), Aug. 24 and 31, 1913.

Wires, Wiring and Conduits

Impregnation of Wooden Poles.—R. Novotny—An article on the economy of the method of impregnating wooden poles with creosote. The author shows that it is possible to reduce the consumption of creosote oil to a smaller amount than is usually employed, although, of course, there is a limit to this reduction.—*Elek. u. Masch.* (Vienna), Sept. 7, 1913.

High-Tension Insulators.—A. Martin-Saxton.—An article on insulators for use above 5000 volts. The author discusses the principal phenomena observed in insulators, the principles determining their form and size, tests of insulators and mechanical requirements.—*Elek. u. Masch.* (Vienna), Aug. 24, 1913.

Preserving Wooden Poles.—R. E. NEALE.—An illustrated description of the Powell saccharine process for seasoning and preserving timber.—London *Elec. Review,* Sept. 19, 1913.

Protection Against Atmospheric Discharges.—P. LANG.—An article on the protection of lines against atmospheric discharges, with special reference to the use of condensers. Formulas are derived which show that the condensers should be installed near the earth and that their capacity should have a certain volume which must not be too high. The author discusses energy losses and the effect of static charges, and compares the results with examples from practice.—*Elek. u. Masch.* (Vienna), Aug. 24, 1913.

Electrophysics and Magnetism

Theory of Contacts Between Bad Conductors.—W. H. ECCLES.—A paper read before Section A of the British association on the theory of the rectifying action of light contacts (such as are used in detectors for wireless telegraphy). The author offers a broad rule which indicates the direction of the rectifying action. This rule is that when the difference of the specific heats of electricity in the two substances in contact is of the same sign as the difference of the Peltier effects, the negative current is greater than the positive current for numerically equal voltages, and when the difference of the specific heats is zero, or is of opposite sign to the difference of the Peltier effects, the greater current is produced by the positive voltage. In fact, according to this electrothermal theory, the Thomson effects, not the Peltier effects, determine the direction of rectification. The evidence in favor of this rule, together with exceptions from it, is discussed.—London *Electrician,* Oct. 3, 1913.

Valve Action of Zirconium.—L. H. WALTER.—An article in which the author shows that while zirconium electrodes do not promise, even when available, to be of any great value in connection with valve cells, the fact that zirconium exhibits a pronounced valve effect is of interest, in that it is the first known case of a metal of the fourth periodic group behaving in this manner. In the same way the metal tungsten is the only example of an element of the sixth group showing this phenomenon.—London *Electrician,* Oct. 3, 1913.

Units, Measurements and Instruments

Magnetic Tests of Sheet Iron.—K. ZICKLER.—If the maximum permeability and the specific electric resistance are known, the author shows how to determine by simple formulas the hysteresis and eddy-current losses and from these the total iron losses in sheet iron. The accuracy obtained is sufficient for technical purposes.—*Elek. u. Masch.* (Vienna), Aug. 31, 1913.

Resonance in Cable Tests.—ANDRÉ LEAUTÉ.—The author refers to his method of using resonance for producing elevated voltages in high-tension cable tests and shows that it can be applied without danger so long as certain precautions are taken to avoid disturbing the equilibrium of the phase of the network under operation.—London *Electrician,* Oct. 3, 1913.

Traction Motor Tests.—In this long illustrated serial on electric-shop testing, tests of direct-current railway motors are taken up.—*Elec. Journal,* September, 1913.

Use of Iron in Electrical Measuring Instruments.—M. DOLIVO-DOBROWOLSKY.—An illustrated English translation of the German article abstracted some time ago in the *Digest.*—London *Elec. Review,* Aug. 8, 1913.

Telegraphy, Telephony and Signals

Induction Coils for Telephone Lines.—L. CAHEN.—A mathematical article with reference to the recent paper of Bela Gati on the use of induction coils in shunt for telephone circuits. The author concludes that this system will stand comparison with the Pupin system of induction coils in series only where the distortion of the current does not represent an obstacle to good hearing. This is improbable, but an experimental trial would be interesting.—*La Lumière Elec.,* Sept. 6, 1913.

High-Speed Telegraph.—A. FRANKE.—The first part of an illustrated description of the new high-speed telegraph manufactured by Siemens & Halske.—*Elek. Zeit.,* Sept. 25, 1913.

Wireless Telegraphy.—H. THURN.—An article giving statistical data on coast and ship wireless stations in different countries. The systems employed are listed according to their status on June 15, 1913, special reference being given to Europe, and especially Germany and the German colonies.—*Elek. Zeit.,* Oct. 2, 1913.

Book Review

AN ELEMENTARY TREATISE ON CALCULUS. By William S. Franklin, Barry MacNutt and Rollin L. Charles. South Bethlehem, Pa.: Published by the authors. 253 pages, illustrated. Price, $2.

Mathematics is a very large subject and may be regarded from many different standpoints. The pure mathematician very commonly regards mathematics as the logic of quantity. To his mind the logical aspect is dominant. The physicist very commonly regards mathematics as the science which explains the phenomena of the material universe. To his mind the explanatory aspect is dominant. The engineer very commonly regards mathematics as the source of rules for reaching swift and reliable arithmetical conclusions in practical engineering problems. To his mind the arithmetical aspect is dominant. The teaching of branches of mathematics, such as the differential or integral calculus, naturally varies with the type of mind that presents the subject and with the type of mind to which it is presented. There is a tendency for conflict between the teachings of pure mathematicians, physicists and engineers. What seems proper to the purist seems stilted to the physicist and obscure to the engineer. What seems proper to the physicist seems loose to the pure mathematician and indefinite to the engineer. What seems proper to the engineer seems trivially utilitarian to the purist and narrow to the physicist.

In the history of the teaching of advanced mathematics the pure mathematician dictated the policy and dominated the field until within a generation of our time. The time-honored ascendency has recently been bitterly contested. The rigid formalism of the fine old mathematical scholars was held up to scorn by the men who desired to make their mathematics into useful tools for the practical mind. No Calvinist indicted the medieval church more vindictively. On the other hand, the loose reasonings of the practitioner type were gall and wormwood to the carefully trained scholar. Between the extremists of these two groups no quarter was ever given or taken. At the present time more tolerance is displayed. All honest types of mathematics are good, in their own way, for the particular minds to which they are addressed. But it has become clear that engineers should learn their mathematics from applied mathematicians and not from pure mathematicians.

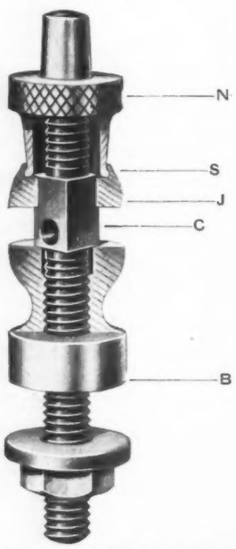
The book under consideration belongs essentially to the physicist-engineer's class. It bases its conceptions on simple physical phenomena and arrives at its conclusions in the most direct and least formal method consistent with practical accuracy. It should, therefore, win favor with students of that class. Perhaps the strongest chapters in the volume are those dealing with wave motion and with vector analysis. These seem to us remarkably good. Those subjects are seldom presented clearly and simply in books on the calculus.

New Apparatus and Appliances

An Illustrated Descriptive Record of Recently Developed Manufactured Products of Interest to Electrical Readers

Improved Type of Binding Post

A binding post which is said to be adaptable to all classes of wire tips and all kinds of wire, and which, it is declared, will form a better mechanical and electrical connection than the ordinary binding post, is shown in the accompanying illustration. The base of the jaw *B* is held stationary in or near the position shown by the lock-nut below it. The non-rotating jaw *J* fits the square copper stud, and as force is applied at the nut *N* the travel occasioned by the screw thread is transmitted through the swivel *S*, bringing the two jaws of the binding post together. The device is made of brass and is designed to carry a current of 30 amp without excessive heating. Special sizes are also made.



IMPROVED BINDING POST

This "standard connection," as it is called by its manufacturer, the Sloan Engineering Company, of Brooklyn, N. Y., is said to insure reliable connections and to reduce trouble resulting from poor contacts.

Portable Incandescent-Lamp Holder

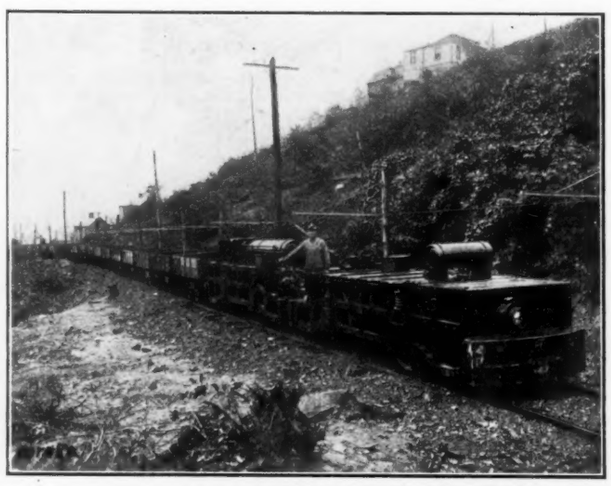
A portable incandescent-lamp holder called the "handilight," which can be supported in several different positions, is being manufactured by the Luminous Unit Company, of St. Louis, Mo. The design of the base makes the outfit adaptable to a variety of conditions. Supported as shown in the illustration, it can be used as an ordinary table or reading lamp. With the goose-neck hooked on the top of a mirror it becomes adapted for shaving. The lamp can also be used as a porch fixture by hanging the slotted portion of the support on a nail or screw. By laying the base horizontally on top of a piano the reflector can be adjusted to illuminate the score. Placed on an office desk the lamp forms a convenient form of portable fixture.

PORTABLE FIXTURE ADJUSTABLE TO SEVERAL POSITIONS

The Largest Mine Locomotives Ever Built

The Carnegie Coal Company has recently installed at the Charleroi (Pa.) Coal Works two of the largest mine locomotives ever built. These locomotives weigh 30 tons apiece and are of the Baldwin-Westinghouse "barsteel" type. It is estimated that each locomotive can haul 100 cars, each loaded with 3 tons of coal, over the grades which will be encountered on the local right-of-way.

Each locomotive consists of two separate units which can be separated and used as 15-ton locomotives if desired. The use of two units in tandem is advantageous in such large machines because the weight is distributed over eight wheels instead of four, and hence the locomotive has


30-TON MINE LOCOMOTIVE

greater tractive power and does less damage to the track than if the weight were more concentrated.

In the "barsteel" construction the frames are not built up of plates but are formed of a grid of steel bars of heavy cross-section. The side frame of each unit is cast separately, giving strong and rigid construction. The openings in the frame afford ready access for inspection, oiling, replacing brakeshoes, adjusting brake rigging, etc., and also provide ventilation for the electrical apparatus, so that its all-day efficiency is higher than would be the case if the frame totally inclosed it. This type of frame has been in use for many years for large freight locomotives but has been adapted for mine locomotives only within the last year.

Both air brakes and hand brakes are provided. An auxiliary air reservoir is placed on the trailing unit, the main reservoir and compressor being located on the leading unit. The hand brakes are operative on both units when disconnected for independent operation.

The controller for the tandem pair is of the individual magnetic blow-out type which handles all four motors at

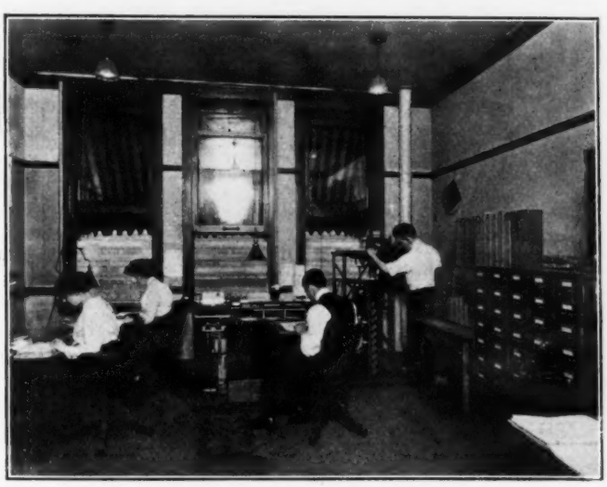
once. When the tandem is split the four-motor controller operates the two motors of its unit without change in connections, while the other unit has its own two-motor controller.

Tabulating Machines for Smaller Central Stations

The Commonwealth Edison Company of Chicago, with more than 100,000 customers on its books, has for several years checked its monthly billing sheets by machinery. A card is punched for each bill and the different cards are then automatically sorted and tabulated for the amounts and class of service. This is done primarily as a check against the correctness of the bill extensions. Beyond this, however, it has the very decided value of forming the basis for all statistical analyses which the company makes with regard to the sale of its service.

The same idea but in a somewhat different form is now being carried out by the Portland (Ore.) Railway, Light & Power Company on the Pacific Coast and by the Cleveland (Ohio) Electric Illuminating Company. Particularly interesting is the use made of the cards for shop accounts, both for labor and material in repair work. The arrangement is such that the aggregate cost in labor and material during any given time can be determined automatically and quickly. If, on the other hand, the cost of a particular kind of work is desired, it can be obtained in the same way by running the cards through the machines again after setting the automatic recording device to catch that particular item.

Soon after the management of one company found that it could obtain through the cards answers to all sorts of special inquiries, the accounting department was almost swamped with requests for information. This, of course, had really been needed just as much before the card system was installed, but, realizing that it could not be obtained except at large expense and irritating delay, very few of the heads of departments had had the temerity to ask for it. Many matters had been allowed to go by default in preference to making a demand which was bound to be reflected



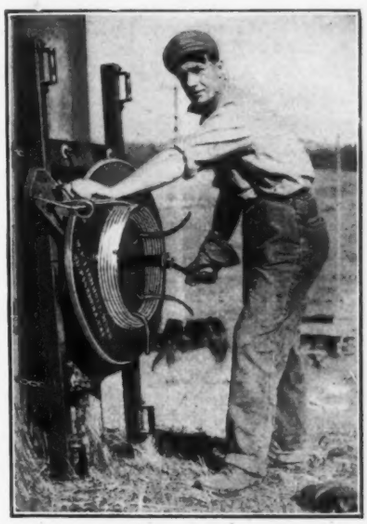
TABULATING MACHINE USED IN OFFICE, CLEVELAND ELECTRIC ILLUMINATING COMPANY

at the end of the next month in the cost sheets of the department.

The illustration shows a complete statistical unit in the office of the Cleveland Electric Illuminating Company. At the left are shown two key punches being operated by two young women, while the gang punch with a quick-set device rests on a table at the right of the picture. The sorter operated by the man standing and the tabulator in front of the man in the chair are the remaining machines in the set. The card files are shown at the left along the wall. All of the machines for the above-mentioned installations of tabulating machines and automatic sorting devices were furnished by the Tabulating Machine Company, New York City.

Combined Take-Up and Pay-Out Reel

Mathias Klein & Sons, of Chicago, are marketing the Eichoff combined take-up and pay-out wire reel which is said to facilitate greatly the handling of electric-light,



COMBINED TAKE-UP AND PAY-OUT WIRE REEL CHAINED TO BASE OF POLE

telegraph and telephone wire, performing the work of both the separate pay-out and take-up reels, with economy in time and labor. The services of but one man are required to operate the Eichoff reel as compared with several men necessary where separate reels are used. The reel disk proper, instead of being made of wood, is of No. 10 galvanized sheet steel, 34 in. in diameter, with a 1-in. flange turned around the edge. An adjustable wire guide enables the operator to coil up wire without assistance. A brake around the hub can be set to hold the wire at any tension or a stop-pin fixes the reel disk stationary. The arms are adjustable, facilitating easy removal of the wire. The axles are made from 0.875-in. cold-rolled steel with cast-iron hub, and the weight of the reel is about 80 lb. As shown in the illustration, the frame, which is provided with handles, can be clamped to a tree or any convenient post which is strong enough to withstand the strain imposed by the pull of the wire.

Indirect Lighting of Chicago Bank Interior

A modern tendency in bank illumination is the lighting of counting-house interiors by the indirect system, concealing the light sources in troughs along the top of the bank rails surrounding the tellers' cages, etc. One of the latest installations of this type is that of the Swedish-American Bank at Balmoral and Clark Streets, Chicago. As shown by the movement of the hands of the clock dial in Fig. 1, the photographic plate from which this reproduction was made was exposed only six minutes, no flashlight or other artificial aid having been used.

The entire absence of pendent fixtures preserves perspective in a remarkable manner, and the beautifully lighted

ceiling, from which the room is actually illuminated, gives the interior a high, spacious and dignified appearance. It would be difficult to secure the same effect by suspending visible light sources from the ceiling, for the eye finds it a task to see past a bright light and the ceiling is visually

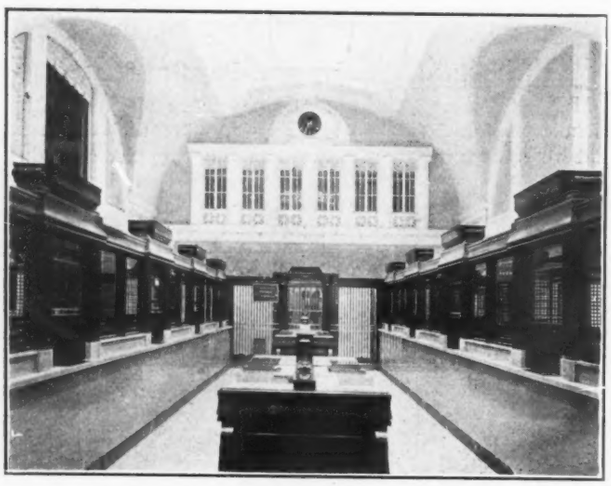


FIG. 1—INDIRECT ILLUMINATION OF INTERIOR OF SWEDISH-AMERICAN BANK, CHICAGO, ILL.

lowered. The lamps in this installation are kept burning at evening solely for the attention attracted and the advertising value which the lighting affords.

The illumination is accomplished by using two 60-watt lamps with reflectors in each of the eight boxes or troughs along the bank rail over the teller's wickets. Besides this, there are four reflectors containing 150-watt lamps over the vestibule entrance, which is not shown in the photograph. Two skylights in the ceiling admit natural illumination during daylight hours, but behind the panes are mounted eight reflectors containing 100-watt lamps which may be lighted to add to the artificial illumination, producing a beautiful effect. The main banking room is 50 ft. long, 32 ft. wide and 26 ft. high, and the reflectors are contained in the rectangular casings on the bank rail and are 9 ft. above the floor.

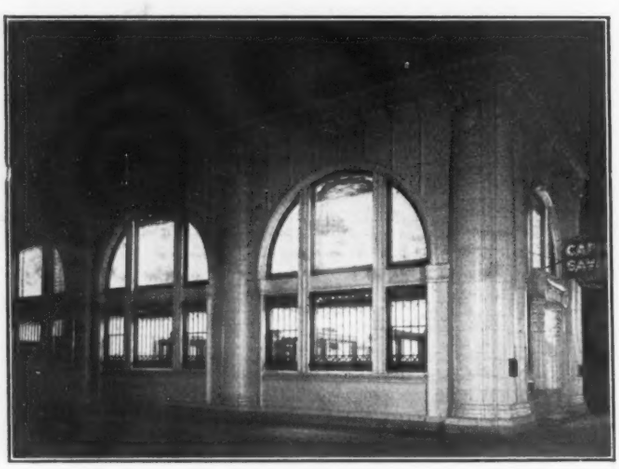


FIG. 2—EXTERIOR VIEW OF SWEDISH-AMERICAN BANK, CHICAGO, AT NIGHT

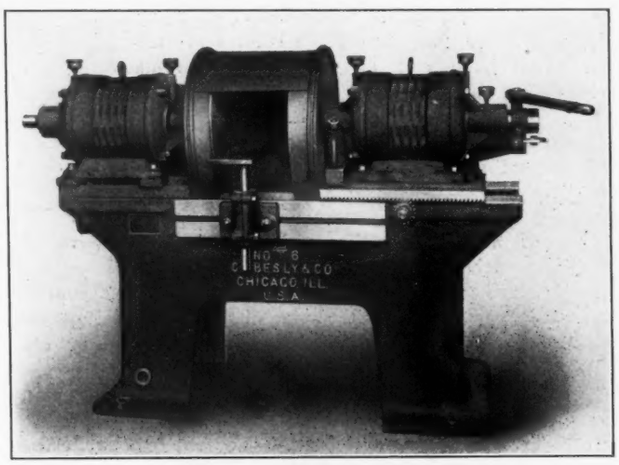
The installation was made by the Pierce Electric Company of Chicago, and the architects were Messrs. Ottenheimer, Stern & Reichert, also of Chicago. The reflector units were furnished by the National X-Ray Reflector Company.

Motor-Driven Doubled-Spindle Grinder

A new 18-in. disk grinder possessing a number of interesting features has recently been developed by C. H. Besly & Company, Chicago. As shown in the illustration, the machine has two disks for grinding two parallel surfaces simultaneously, each grinding disk being mounted on the shaft of a motor. The right-hand motor and its disk can be moved by means of a gear and rack and can be clamped at any desired distance within a maximum of 10 in. from the other disk. In order to bring the disks in contact with the work the shaft and disk of the right-hand motor can be moved forward about 1 in. by means of the lever. A micrometer stop screw, graduated to 0.001 in., limits this motion so that work can be ground very accurately.

The dust hood telescopes automatically as the distance between the disks is varied. Ten work-rests, varying in size from 0.25 in. to 5.3125 in. in width and suitable for all sizes of work within the rating of the machine, are regularly furnished with the grinder.

The motors are of the Westinghouse steel-frame induc-



DOUBLE-SPINDLE DISK GRINDER WITH INDUCTION MOTOR DRIVE AND MICROMETER ADJUSTMENT

tion type with special bearing brackets to carry the unusually large bearings required for grinding service. Each motor is rated at 5 hp.

Elevated Controllers

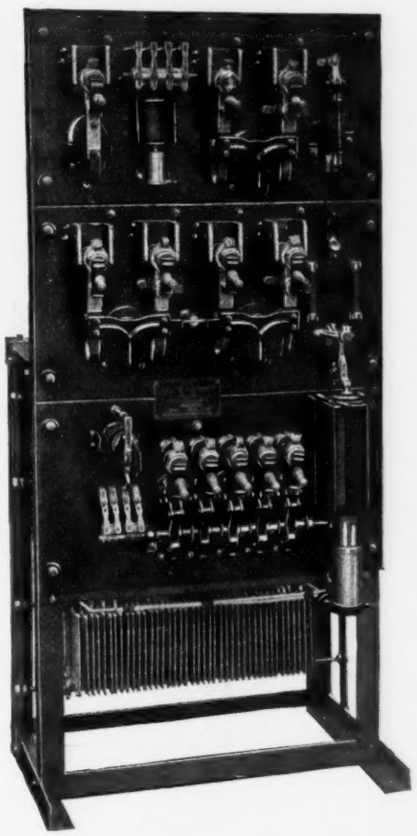
Elevator controllers of the type shown herewith are now being produced in both single-speed and two-speed types. The single-speed types are used with motors having no field control, while the two-speed types are used with motors in which additional speed variation is made possible by shunt-field resistors. In both types a combination of armature-series and shunt-field resistance will slow down the elevator and bring it to a stop if any part of the equipment fails to function properly. The armature shunt resistance is used also for dynamic braking.

The magnetic switches mounted on the slate control panel can easily be taken apart for inspection or for renewal of the contacts. All switch arms have a channel section and the other parts are heavily ribbed where required, so as to eliminate the breakage. All electrical contacts on these panels are of the butt type, carbon to copper and have a wide range of adjustment for taking up wear. Dust and dirt cannot collect on the contacts because of their vertical position.

The main contacts are equipped with magnetic blow-out coils of bar-wound copper. These are mounted on the

back of the control panel, so that the coils cannot be damaged from the arc. All of the wiring is exposed on the back of the panel. A double-pole main-line switch breaks both sides of the line and in connection with the direction switches gives four breaks in the armature circuit. The direction switches are mechanically interlocked to prevent their simultaneous operation, which would cause a short-circuit on the line. These switches will also automatically open on abnormal drop in voltage and stop the equipment.

A double-coil overload movement is arranged to stop the elevator in case of overload and can be automatically reset by throwing the car switch to the off position. This gives a reliable indication as to whether the car is overloaded, and by having the resetting feature in the car switch it is possible to set this overload within the closest



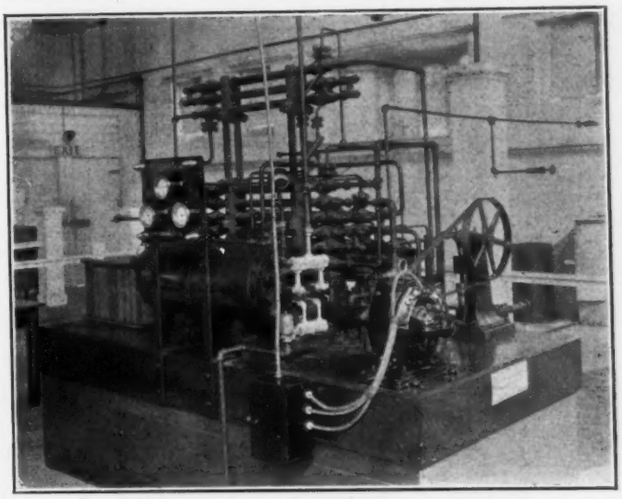
TYPE OF CONTROLLER PANEL WITH NEW SINGLE AND TWO-SPEED ELEVATORS

limits. This device possesses an advantage over the hand-operated circuit-breaker in that the operator is not compelled to go to the switchboard in case a slight overload occurs.

The controllers described above are now being built by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis.

Combination Electric Plant and Refrigerating Equipment

A complete miniature exhaust-steam ice plant having a rating of 0.5 ton of refrigation was exhibited in operation at the International Refrigeration Exposition in Chicago by the Carbondale Machine Company, of Carbondale, Pa., to demonstrate the applicability of the absorption-type ice plant to central-station equipment. Live steam was supplied to a small vertical engine direct-connected to a 3.5-kw 110-volt direct-current generator. This electrical unit was furnished by the Engberg Electrical & Mechanical Works, of St. Joseph, Mich. The engine exhaust at 3-lb. pressure was conducted to the steam coils of the ammonia generator of the small absorption-type refrigerating machine.

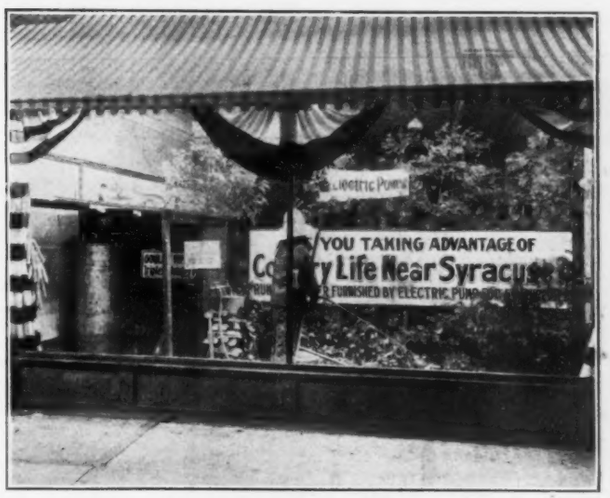


MODEL EXHAUST-STEAM REFRIGERATING MACHINE

Here the latent heat of the steam was utilized to distil off ammonia gas, and the refrigerant produced was used to operate a frosted sign, and to freeze small cakes of ice. The illustation herewith shows in detail the model refrigerating machine. Electricity from the generator was used in the operation of the small Robbins & Myers motor shown, which drove the ammonia circulating pump used in returning aqua ammonia from the absorber to the ammonia generator.

Stimulating Electric Pumping at Syracuse, N. Y.

The accompanying illustration shows a window display used by the Syracuse Lighting Company, Syracuse, N. Y., to interest the suburban and country residents in electric



WINDOW DISPLAY TO INTEREST SUBURBAN AND COUNTRY RESIDENTS

pumping. The exhibit consists of an electrically driven triplex pump (shown in the lower-left corner of the picture) discharging into a pressure tank at its side. As the dummy figure pours the water on the flower garden in the foreground the pump is automatically stopped and started

by means of a pressure relay on the tank. Appropriate posters in the window called attention to the advantages of the electrically driven pump as an aid in times of drought and fire. The pump in the display was made by the Goulds Manufacturing Company, Seneca Falls, N. Y.

Change in Condensing Turbine Design

In making recent improvements in the design of its small turbine units, the Terry Steam Turbine Company, Hartford, Conn., had two objects in view, namely, to approach the low rates of steam consumption achieved with larger units and to eliminate air leakage into the condenser. The

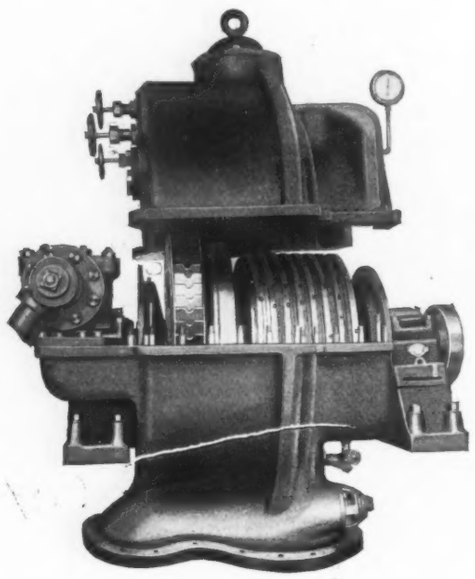


FIG. 1—STEAM TURBINE, WITH CASE REMOVED, EXPOSING ROTATING ELEMENT

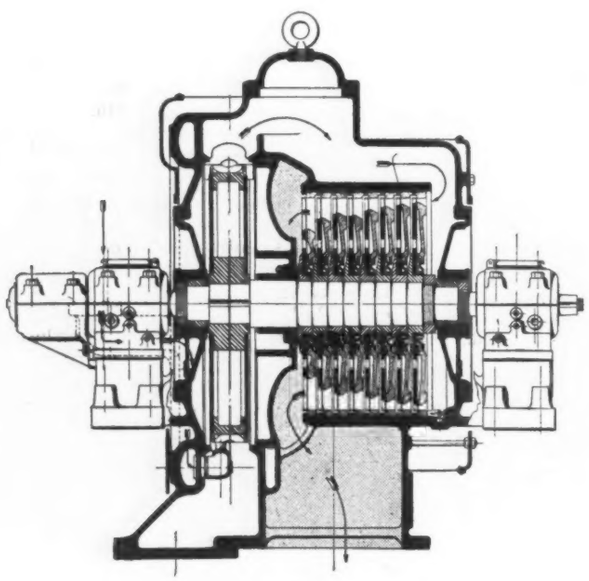


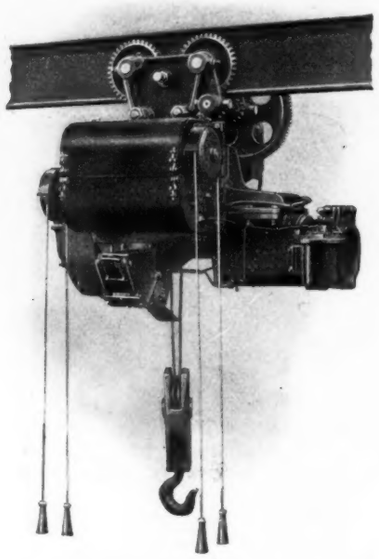
FIG. 2—SECTIONAL VIEW THROUGH STEAM TURBINE, SHOWING PATH OF STEAM TO CONDENSER

machine consists essentially of a multi-velocity wheel as the high-pressure element and a low-pressure end made up of several multi-pressure impulse elements. The main feature distinguishing the arrangement of the low-pressure stage from that used in some other types lies in the fact that the low-pressure element is here reversed and receives steam at the end farthest from the high-pressure element, exhausting into the condenser connection at the center of the turbine as shown by the path of the arrows in Fig. 2. The stationary buckets on the low-pressure end are placed on annular rings, from which they may be removed in blocks if necessary.

The only gland exposed to vacuum has been shifted from the end of the casing, as it is in other types of condensing turbines, to the middle, where it is exposed on one side to the action of a vacuum and on the other to steam at just above atmospheric pressure. This reduces the leakage of air through this gland to a minimum. The effectiveness of the gland does not depend upon packing or any of the other devices used to keep out the air. Aside from these changes the turbine has the same characteristics as the former machines made by the company which have been described from time to time in the columns of the *Electrical World*.

Hoist for Shop, Factory or Warehouse Duty

In a new type of small shop hoist brought out by the Pawling & Harnischfeger Company, Milwaukee, Wis., plain spur gears are used throughout, all worm, bevel and planetary gearing having been eliminated as being inefficient. The gears employed are of cast steel and the pinions are of hardened forged steel. The load brake and hoist gears run immersed in oil. The designer has also given much attention to making all parts of the hoist accessible.



SMALL SHOP HOIST WITH SPUR-GEAR EQUIPMENT AND FLOOR CONTROL

Unless otherwise specified, these hoists are equipped with direct-current motors. In sizes above 2 hp they are built with four wound-field poles, cast-steel frames and laminated cores. The armatures are form-wound, and both armature and field coils are impregnated under vacuum to render them impervious to moisture and oil. The motors are built for all standard potentials up to 600 volts. If alternating-current motors are specified, they may be furnished for two-phase or three-phase circuits of pressures ranging from 110 volts to 550 volts. These motors are of the slip-ring type. Drum-type controllers with many speed points are used with both alternating-current and direct-current motors.

Industrial and Financial News

Public Utility, Commercial, Corporate and Trade Developments—The Electrical Material and Security Markets

Electrical Exports During July, 1913.—Government figures on the exports of electrical machinery and appliances from the United States during the month of July show the following values for items of largest significance: Batteries, $44,084; generators, motors and transformers, $955,682; fans, $40,217; insulated wire cable, $147,948; interior wiring supplies and fixtures, $68,695; lamps, $69,852; telegraph instruments, $3,402; telephones, $77,969; locomotives, $4,780; miscellaneous, $910,643. The value of the copper and copper manufactures exported during the same period was $11,290,445.

Ornamental Street-Lighting Business Brisk.—At least one of the makers of ornamental street-lighting poles is making active preparations for the commercial appearance of the new high-efficiency tungsten lamps in the street-lighting field. This concern expresses the opinion that the municipal lighting situation will ultimately develop into the use of single high-intensity lighting units, in place of the varied line of two, three, four and five-lamp clusters at present largely in demand. This concern is pushing its sales in all sections of the country and claims that it is having trouble in keeping the production up to the demand. Among the cities which have recently placed orders with it for lighting-pole equipment are Holyoke, Mass., with 62 poles; Schenectady, N. Y., with 62; Edmonton, Alta., with 76; Lewiston, Me., with 100, and Brantford, Ont., with 152 poles. All of the above poles are for use with single-arc lamps.

New Electrically Operated Washer Finding Large Western Sale.—The new perforated cylinder type of electrically operated washing machine, recently put out by the Conlon Electric Washer Company, of Chicago, is finding its best sale, according to a representative of the company recently interviewed, in Chicago and the West. The apparatus embodies the advantages of compactness, durability and simplicity, having a geared shaft-drive with single lever control. There is provided also a reversing lever control for the wringer attachment. This company is finding, as a number of the cooking appliance concerns also report, that the Western part of the country furnishes a good field for quick sales where the class of apparatus can prove its merit. The extension of power and lighting service is being carried on with great rapidity in that section, and there is less capital tied up in old apparatus. These facts combine to produce a good demand for all sorts of electrical appliances.

Continuous Dump Stoker Perfected.—The American Engineering Company, which has been working for some time on a continuous dump Taylor stoker, has finally produced a machine which embodies this feature. A set of the new stokers is in satisfactory operation at the company's plant at Philadelphia, and similar apparatus has been tried out successfully under the boilers of the Detroit Edison Company. The new device makes it possible to remove ashes without admitting excess air to the combustion chamber, allowing the boilers to be operated continuously at large overloads without any interruption for cleaning the fire. An installation of these stokers is being made in the Fifty-ninth Street power house of the Interborough Rapid Transit Company in New York City, where the change from the old-type stokers is being made four boilers at a time, as rapidly as the work can be carried on without interfering with the operation of the station. Several other large orders for this apparatus are pending.

Reduction in Prices of Electrical Manufactures Expected.—Speaking recently concerning the probable effect of the new tariff rates on the electrical industry as a whole, a representative of one of the leading manufacturing interests expressed the sentiment that a general reduction of prices on electrical manufactures will soon be noticed, involving either a reduction in the margin of profit of the makers or in the wages of the labor employed, or both. According to this manufacturer, Germany, as the largest maker of electrical goods in Europe, is the most probable competitor of the American manufacturing interests. He claims that the German laborer, getting 60 per cent of the wage of the American, is equally efficient and that this gives the manufacturer of that country an advantage in the matter of selling price of goods. Aggressive competition is not expected to mature at once, since the foreign manufacturers will have to enlarge their production and organize sales forces to handle their goods in this country, but it is predicted that in two or three years the full effects of their presence will be felt in the electrical industry of the United States.

Santo Vacuum Cleaner Sales Excellent.—The Santo Electric Appliance Company, of 168 Madison Avenue, New York, agent for the Keller Manufacturing Company, of Philadelphia, in New York and vicinity, claims that at the present time it does no soliciting and has no regular sales force, since the volume of inquiries is large enough to keep its force of demonstrators busy. The Santo vacuum cleaner, handled by this concern, is of the flexible diaphragm type, and it is claimed that it gives a higher and more steady vacuum than can be produced by the centrifugal fan type of cleaner, while the diaphragm of canvas, impregnated with rubber, is said to show little wear after long usage. Sixteen of these cleaners have recently been installed on the *Imperator*, and one has been sold for use in the Engineering Societies Building in New York. A point of interest in connection with this company's work is the fact that it has begun to have a call for repairs and replacements on the machines first sold and has been obliged to install a repair department to care for this demand. In order to stimulate the purchase of the newer and more efficient machines, the company offers an allowance on the older types of Santo cleaners, if it is desired to return the same in part payment for new machines.

Westinghouse Electric Equipment Sold for Public Utility Purposes.—Electric railway companies and central stations have been active buyers of generating and substation apparatus from the Westinghouse Electric & Manufacturing Company during the past few weeks. An order has been received from the Pittsburgh Railways Company, Pittsburgh, Pa., for three 500-kw, 600-volt, six-phase, 60-cycle rotary converters with three 550-kva, 22,000-volt, three-phase transformers and one 14-panel switchboard for the control of same. From the United Railways & Electric Company, Baltimore, Md., an order has been taken for a 2000-kw, 600-volt, six-phase, 25-cycle, commutating-pole rotary converter; three 750-kw, 13,200-volt air-blast transformers and switchboard. The Edison Electric Illuminating Company, Boston, Mass., has placed an order for a 750-kw, 575-volt, six-phase, 60-cycle, commutating-pole rotary converter with two 825-kva, 13,200-volt, three-phase air-blast transformer and two blower outfits for same. A sale has been made to the Cleveland, Painesville & Eastern Railway Company, Willoughby, Ohio, of two 500-kw, 600-volt, six-phase, 25-cycle, commutating-pole rotary converters. Other interests which have placed orders with the same company for electrical equipment of various kinds within the last month or two are the Oakland, Antioch & Eastern Railway Company, Oakland, Cal.; Duquesne Light Company, Pittsburgh, Pa.; Milford & Uxbridge Street Railway Company, Milford, Mass.; Greenville, Spartanburg & Anderson Railway Company, Spartanburg, S. C.; Chautauqua Traction Company, Jamestown, N. Y., and S. S. Bullis, Medford, Ore.

American Asbestos Production in 1912.—The production of asbestos in the United States during 1912, was 4403 short tons, or a decrease of 3201 short tons from the 1911 figures. Even with this 72 per cent reduction the total for 1912 was the second largest yearly production on record. Most of the asbestos mined in this country comes from Vermont and Georgia, and a little is obtained from Wyoming. The finest quality asbestos is found in the Grand Canyon of the Coloardo in Arizona, but this deposit is not commercially accessible. Asbestos, when free from magnetite, is an excellent electric insulator and its field of particular usefulness lies in service where its fire-proof and heat-insulating qualities are also desired, notably, as a covering for electric wire and cable, as a lining for street car controller boxes, and as insulation in various electric heating and cooking appliances.

Waverley Electrics Sold to Central Stations.—Six light shaft-driven electric delivery wagons were recently sold to the New York Edison Company by the Waverley Company, which reports that similar cars have enjoyed an increasing popularity in this country and in Canada. Central stations are coming generally to believe that the use of electric vehicles for their delivery and repair work is a paying investment both in the direct economies achieved and in the indirect advertisement for electric service which such use provides. Among the larger central stations which have recently purchased Waverley cars for this service are the Edison Electric Illuminating Company of Boston, the Commonwealth Edison Company of Chicago, the Denver (Col.) Gas & Electric Company, the Louisville (Ky.) Lighting Company, the British Columbia Electric Railway Company, of Vancouver; the Merchants' Heat & Light Company, of Indianapolis, Ind., and the Duquesne Light Company, of Pittsburgh, Pa.

Electrical Devices on 1914 Models of Gasoline Automobiles.—Although the season is still young and in a large number of cases the manufacturers have only decided upon the chassis design for their 1914 models, it is interesting to compare figures on electrical accessory equipment so far planned for next year's gasoline automobiles with those for this year's cars. Of the 50 makers, comprising a recent listing for this purpose, 41 of whom had electric starters on their 1913 models, 19 have decided upon the type of electric starter for their 1914 cars. Electric lighting equipment was regularly placed in this year's cars by 42 of these makers, and 16 have so far decided on this equipment for the coming year. Ignition magneto apparatus was installed by 44 of the same manufacturers in 1913, and already 20 of them have fixed on this element in their 1914 designs. Auxiliary battery equipment was supplied by 26 of these makers in 1913, and 12 have signified their choice of similar equipment for 1914. It is of interest to note that of this list of 50 leading manufacturers, 22 equipped their cars electrically in all four of the above items in 1913, while so far 10 have indicated that their 1914 models will be so equipped.

Industrial Motor Drive Supplied by the General Electric Company.—The General Electric Company has recently obtained from some of the large steel companies extensive orders for electric power equipment. The biggest single order reported is that of the Republic Iron & Steel Company, of Birmingham, Ala., which concern plans the installation at its mills, at Thomas, Ala., of a 400-kw motor-generator set, a 250-kva synchronous motor, five 150-kva transformers, seven motors ranging from 5 hp to 100 hp, switchboard and accessories, and will place in operation around the yards and buildings four 8-ton electric industrial locomotives. The same company will add to the electric drive equipment at its Youngstown (Ohio) plant thirteen motors, ranging from 10 hp to 350 hp, together with control panels. Other concerns which have recently put in orders for similar equipment are the American Steel & Wire Company, of Cleveland, Ohio; the Forged Steel Wheel Company, of Butler, Pa.; the Bethlehem Steel Company, of South Bethlehem, Pa., and the Otis Steel Company, Cleveland, Ohio. The sale of this class of apparatus is not, however, confined to the steel industry. The Singer Manufacturing Company, of New York, has ordered from the General Electric Company a 5000-kw, 2300-volt Curtis turbo-alternator for installation at its plant in Elizabethport, N. J. The California Portland Cement Company, Los Angeles, Cal., in equipping its mill at Colton, Cal., for electric drive, will install thirteen 75-hp and six 150-hp motors with a switchboard and accessories. Sixty-five induction motors ranging in capacity from 1 hp to 50 hp have been ordered for electric-drive purposes in the carpet factory of S. Sanford & Son at Amsterdam, N. Y. The Ludlow Manufacturing Company, Ludlow, Mass.; American Printing Company, Fall River, Mass.; Farr Alpaca Company, Holyoke, Mass.; National Lead Company, New York, N. Y.; Buda Company, Harvey, Ill.; Pennsylvania Feldspar Company, Rochester, N. Y., and the International Harvester Company, Chicago, Ill., are among the other concerns which have lately decided to install General Electric equipment in connection with their manufacturing operations.

Tennessee Hydroelectric Development to Supply Aluminum Industry.—Operation began this week at the Ocoee No. 2 plant of the Eastern Tennessee Power Company, located on the Ocoee River, near Parksville, Tenn. This generating station, which was built and equipped by the J. G. White Engineering Corporation, of 43 Exchange Place, New York, has a capacity of 20,000 hp, with provision for future extension to 30,000 hp, and the energy generated will be largely used in the manufacturing of aluminum, as well as in the lighting and traction service in the adjoining towns. The plant is located in the mountains and the water is conducted to it in a flume 4 miles long, feeding into a steel penstock. The operating head is 250 ft. and the construction and equipment work, which has covered a period of fifteen months, has cost in the neighborhood of $2,000,000. A ground area of 125 ft. by 80 ft. is occupied by the station, which is of concrete and brick construction. Two 9375-kw, 6600-volt, three-phase, 60-cycle General Electric generators are installed, driven at 360 r.p.m. by I. P. Morris turbines and having exciters directly connected to the drive shaft. Provision has been made for the installation of a third unit of similar capacity. The other electrical equipment in the station consists of two three-phase, 60-cycle, 6600/66,000/120,000-volt transformers, oil-switching equipment, electrolytic lightning arresters, and a 50-kw motor-generator set for battery charging, station lighting and electric crane operation. All of this apparatus was furnished by the General Electric Company. Pneumatically operated disconnecting switches are installed, and the station equipment includes a 50-ton electric crane. At the present time the station is operating at 66,000 volts in order to work with the Ocoee No. 1 plant, but eventually the transmission voltage will be 120,000. It is planned to carry energy to Knoxville, Chattanooga and Nashville, and the transmission system so far completed consists of two wooden-pole lines and one double-circuit steel-tower line. The suspension-type insulators used on this system were supplied by the Ohio Brass Company. The construction and equipment of this plant was carried on under the supervision of J. G. Munson.

NEW YORK METAL MARKET PRICES

	Oct. 14 Bid.	Oct. 14 Asked.	Oct. 21 Bid.	Oct. 21 Asked.
Copper:				
Standard, spot*				
	Selling Prices		Selling Prices	
	£ s d		£ s d	
London, standard, spot*	70 10 0		74 17 6	
Prime Lake	16.50		16.75	to 16.87½
Electrolytic	16.15	to 16.25	16.50	to 16.70
Casting	16.00	to 16.12½	16.37½	to 16.50
Copper wire base	17.25		17.50	to 17.62½
Lead	4.50		4.35	
Nickel	40.00	to 45.00	40.00	to 45.00
Sheet zinc, f.o.b. smelter	7.75		7.50	
Spelter, spot	5.35	to 5.45	5.35	to 5.45
Tin, spot	40.25	to 40.45	40.00	to 40.20
Aluminum:				
Prompt delivery	20.00	to 21.00	20.00	to 20.50
Future	20.00	to 20.50	19.75	to 20.25

***OLD METALS**

Heavy copper and wire	15.00	15.00
Brass, heavy	9.75	9.75
Brass, light	8.50	8.50
Lead, heavy	4.50	4.20
Zinc, scrap	4.75	4.37½

***COPPER EXPORTS**

Total tons to Oct. 21 17,024

*From daily transactions on the New York Metal Exchange.

Corporate and Financial

Keystone Telephone Company Declares Initial Dividend.—The directors of the Keystone Telephone Company of Philadelphia have declared an initial dividend of 3 per cent out of the earnings of the preceding six months. This is to be paid on the preferred stock of the company, on which there are accumulated unpaid dividends of 63 per cent. For the nine months ended Sept. 30 the company's gross earnings were $944,417, while net earnings were $465,112.

Power Debentures Offered in London.—An issue of £560,000 of 4½ per cent perpetual debenture stock of the Vancouver Power Company, guaranteed unconditionally, principal and interest, by the British Columbia Electric Railway Company, is offered in London at 88. The issue is made to provide for obligations arising from an increase in the generating capacity of the Vancouver Power Company and also of the Vancouver Island Power Company, a subsidiary.

Capital Stock of Boston Utility Increased.—The stockholders of the United Electric Light Company, of Boston, have voted to increase the capital stock of the company from $1,500,000 to $1,750,000 in order to provide funds for extensions of its plant. The new stock is to be issued at 200 in accordance with a decision of the Gas and Electric Light Commissioners on Sept. 5. Payment must be made on half of this stock by Jan. 6 and on the remainder by April 6, and subscriptions must be made prior to Jan. 1, 1914.

Electric Transmission Company Changes Hands.—The control of the Electric Transmission Company, of Bristol, Va., organized a year ago by B. L. Dulaney, is said to have been acquired by Samuel Insull, president of the Commonwealth Edison Company, of Chicago. This company was started for the purpose of generating electricity with unmarketable coal from the mines of southwestern Virginia and supplying industries along the Atlantic seaboard, the particular field in view being the manufacturing industries in the Piedmont region. It is reported that Mr. Insull proposes to construct transmission lines to carry the energy to other markets.

Beaver River Power Company Purchased.—The Idaho Power & Light Company, organized by L. L. Nunn and associates, has taken over the properties of the Beaver River Power Company, at Bliss, Idaho, and at Beaver, Utah, together with the transmission and distributing lines supplying electricity to Boise and other towns in Idaho and Utah. With this move the 10,000-hp hydroelectric generating station on the Malad River and all the franchises of the old company were acquired. L. L. Nunn, formerly general manager of the Telluride Power Company before its absorption by the Utah Power & Light Company, is now president of the Idaho Power & Light Company.

Electric Company of America Finances.—Arrangements have been made whereby stock of the Electric Company of America deposited between Oct. 24 and Nov. 1 with Cassatt & Company, of Philadelphia, may be exchanged for its equivalent at $14 per share in either $100 or $1000 bonds of the American Gas & Electric Company, fractional amounts being made up in negotiable scrip. In case the bonds of $1000 denomination are desired, delivery will be made on stock deposited on or before Dec. 1. Holders of the $100 bonds who wish to exchange them for their equivalent in $1000 bonds may do so by depositing them in multiples of ten with Cassatt & Company between the dates mentioned. A distribution of 35 cents per share is payable on stock of the Electric Company of America on Nov. 1.

American Water Works & Guarantee Company Protective Committees.—As announced in the Oct. 11 issue of the *Electrical World*, a protective committee has been formed. This committee, consisting of G. L. Edwards, H. C. Ward, Robert Wardrop, E. F. Shanbacker, Allan Forbes, H. S. Cole, M. B. Moon, J. H. Puelicher, W. A. Durst, A. B. MacCaughey, W. J. Davis and L. L. McClelland, is asking for the deposit of bonds of the Twin Falls-Oakley Land & Water Company, Twin Falls-North Side Land & Water Company, Twin Falls-Salmon River Land & Water Company, and the Sacramento Valley Irrigation Company. The intention is said to be to organize the irrigation properties independently, separating them from the water-works and electric light, power and railway properties, none of which has so far defaulted on payments of coupons or dividends on bonds or preferred stock held by the public. The depositary is the Safe Deposit & Trust Company, of Pittsburgh, Pa. In order to protect the interests of holders of the 5 per cent gold bonds of the California-Idaho Company, which were guaranteed by the American Water Works & Guarantee Company, a protective committee has been formed, composed of A. W. Krech, Paul Staes, W. K. Whigham, W. C. Audenried, Jr., and H. L. Burrage.

Agawam Power Company Purchased.—The Amherst Power Company, of Greenfield, Mass., has purchased the Agawam (Mass.) Power Company. A reduction of 20 per cent in local lighting rates, as well as lowered motor-service, is now in effect in Agawam. The Amherst company has begun to supply energy to the Lane quarries in Westfield and is now furnishing electricity to the Ramapogue Ice Company's plant in the West Springfield district. A distribution line has been completed to the local pumping station at Bear Hole reservoir and motors will shortly be installed.

Annual Report of the Consolidated Gas, Electric Light & Power Company.—The annual report of the Consolidated Gas, Electric Light & Power Company, of Baltimore, for the fiscal year ended June 30 shows an increase of $649,686 in gross income, or 11.9 per cent, over the figures for last year, and an increase of $329,393 in net earnings, or 11.6 per cent, as compared with the corresponding item for 1912. Sales of electric energy increased 20.4 per cent. During the year 95.8 per cent of the total output of electricity was purchased from the Pennsylvania Water & Power Company, generated at its hydroelectric plant at Holtwood, Pa. Four additional substations were erected by the company, its Westport generating station further enlarged and equipment added to its principal substations. The industrial power department closed a number of large additional contracts for power service, including a single contract with the Maryland Steel Company for 7500 hp. On May 1 the company acquired control of the property and business of the Patapsco Electric & Manufacturing Company, thus adding 1037 electric customers and bringing under its control the only territory in the vicinity of Baltimore at that time not exclusively supplied by it. The plan was tried with some success of offering stock for subscription by the employees of the company on easy payment terms, the result being the disposal of about 1000 shares in lots of from one to twenty-five. Out of the earnings for the year a special reserve fund has been set aside for a new business campaign and extraordinary expenses.

Annual Meeting of the Boston Edison Company.—The twenty-eighth annual report of the Edison Electric Illuminating Company of Boston has been issued, covering the fiscal year ended June 30, 1913. At the annual meeting on Oct. 14 President Edgar stated that for the past three months the business of the company has grown at the rate of 10 per cent per annum, or at practically the same rate as for the year ended June 30. The directors were authorized to apply to the Board of Gas & Electric Light Commissioners for authority to issue 22,756 shares of additional capital stock to finance improvements, the price to be announced at the hearing before the board. President Edgar's report points out that the reduction in the retail price for electricity from 11 to 10 cents per kw-hr. in March, 1912, has saved the company's customers about $200,000 per year. During the year an additional turbo unit of 15,000-kva maximum rating has been purchased for installation in the South Boston station in the spring of 1914. With the exception of the year 1910, when various electric properties were purchased by the company, the increase in the connected load has been far greater than in any previous year. The present connected load is more than double that of five years ago, and amounts to 3,502,925 50-watt equivalents. Three new substations are being built by the company and another is contemplated in Dorchester. With the exception of the laboratory and one or two other structures, the new service buildings of the company on Massachusetts Avenue, Boston, are now substantially completed. The company's territory now embraces over 700 sq. miles, and the connected motor load aggregates 93,175 hp, compared with 78,733 hp in 1912.

Business Notes

The Philadelphia Storage Battery Company has moved its office and depot in Chicago to the Moon Building, 2612 and 2614 South Michigan Avenue. Mr. D. C. Arlington is in charge.

Byron T. Mottinger & Company, with address at Akron, Ohio, have been formed by Byron T. Mottinger, formerly associated with the Youngstown (Ohio) Armature & Construction Company.

The American Conduit Manufacturing Company, of Pittsburgh, Pa., announces the addition to its sales staff of E. H. Sutton, who will act as special representative of the company, with headquarters at Pittsburgh.

Moloney Electric Company.—The Moloney Electric Company, St. Louis, Mo., manufacturer of transformers, is being represented in Philadelphia by the Elliott-Lewis Electrical Company, Inc., 138 North Tenth Street.

The Bentz Richardson Company, Ltd., of 114 Phœnix Block, Winnipeg, Man., has recently been organized to introduce and promote the sale of high-class electrical specialties throughout western Canada.

The Adams-Bagnall Electric Company has opened a branch office at 1318 Pine Street, St. Louis, Mo., in charge of W. L. Cummiskey. At this office there will be carried a full line of electrical supplies and automobile accessories.

Sloan, Huddle, Feustal & Freeman, consulting engineers, of Madison, Wis., announce the formation of their partnership, succeeding the firm of Sloan, Huddle & Company. They announce also the opening of an office in Indianapolis, Ind., in the Hume-Masur Building, with Mr. Huddle in charge.

Kerry & Chace, Ltd., have been incorporated to carry on operations as consulting, constructing and operating engineers with a head office in Toronto. The firm succeeds the consulting engineering firm of Smith, Kerry & Chace, the reorganization having been necessitated owing to the death of Mr. Smith on June 29.

Robert W. Hunt & Company, engineers, of Chicago, Ill., announce the re-election of Mr. T. C. Irving, Jr., as vice-president in charge of the Toronto business. Mr. C. C. Whittier has been made treasurer and general manager of Robert W. Hunt & Company, Ltd., with headquarters at 905 McGill Building, Montreal. Mr. R. N. Dickman has become associated with both the American and Canadian companies and is engaged in the examination of gypsum and coal properties in Western Canada.

New Industrial Companies

The Northwestern Electric Castings Company, of Chicago, Ill., has been incorporated with a capital stock of $10,000 by Herschel V. Shepard, Howard W. Lewis and William T. Church.

The Electrical Specialties Company, of Newark, N. J., has been incorporated by M. Mazzolia, of Kearney; G. C. Tramer and H. C. Tramer, of Newark. The company is capitalized at $100,000 and proposes to manufacture electrical appliances.

The Multi-Lux Illuminating Company, of Cleveland, Ohio, has been incorporated with a capital stock of $25,000 for the purpose of manufacturing electric-light fixtures. The incorporators are: E. M. Smith, H. W. Kackley, H. S. Malm, Ira O. France and W. H. C. Towler.

The Collins-Wagner Manufacturing Company, of Brooklyn, N. Y., has been chartered with a capital stock of $15,000 to manufacture electric fixtures and works of art. The incorporators are: Henry M. Kahle, Charles Wagner and Arthur V. Collins, 16 Dunham Place, Brooklyn, N. Y.

The Auto Electric Equipment Company, of Buffalo, N. Y., has been incorporated by Edward W. Werick, Charles H. Werick and Fred C. Schoenthal, all of Buffalo, N. Y. The company is capitalized at $15,000 and proposes to manufacture and deal in electric generating machinery and appliances.

Trade Publications

Lamp Efficiency.—The General Electric Company has just issued Bulletin No. A4142, which deals exhaustively with various operating conditions which affect the efficiency and life of incandescent lamps.

Lighting Fixtures.—The F. W. Wakefield Brass Company, Vermilion, Ohio, is mailing to dealers a folder relative to its lighting fixtures in which reasons are given for dealers carrying its interchangeable fixtures.

Flashers.—A large poster being mailed by the Reynolds Electric Flasher Manufacturing Company, 617 West Jackson Boulevard, Chicago, contains a suggestion to install flashers on electric signs in order to increase their attractiveness.

Galvanometers.—The Leeds & Northrup Company, 4901 Stenton Avenue, Philadelphia, in a leaflet recently issued has announced a reduction in the prices of its small portable galvanometers. In Bulletin 232 the D'Arsonval galvanometer is described and illustrated.

Pyrometers.—The Industrial Instrument Company, Foxboro, Mass., has issued Bulletin No. 81, relating to electric pyrometers, fire bars and fittings, high-resistance pyrometers, platinum couples, porcelain and quartz tubes and various methods of application.

Commutator Grinder.—The Phillips automatic commutator grinder, a device for truing commutators running in position at normal speed, is described in an eight-page pamphlet recently issued by the Phillips Manufacturing Company, 60 Wall Street, New York.

Resistance Thermometers.—A sixteen-page pamphlet on resistance thermometers for long-distance measurement, registration and alarm has recently been issued by the Hanovia Chemical & Manufacturing Company, 233 New Jersey Railroad Avenue, Newark, N. J.

Receptacles.—In P. & S. Bulletin No. 760, issued by Pass & Seymour, Inc., Solvay, N. Y., illustrations of a large number of electric signs in various parts of the country are shown, in all of which P. & S. sign receptacles are employed. Various types of sign and outlet boxes are illustrated.

Hoisting Machinery.—The Otis Elevator Company, Eleventh Avenue and Twenty-sixth Street, New York, has issued a pamphlet entitled "Automatic Hoisting Machinery Used in Connection with Blast Furnaces," which was distributed at the recent New York convention of the Association of Iron and Steel Electrical Engineers.

Meters.—Ampere-hour meters for general service are the subject of Bulletin No. 36 recently issued by the Sangamo Electric Company, Springfield, Ill. The construction features, the uses and the applications of this device are analytically and diagrammatically set forth. A price list is also given. The bulletin is well printed and illustrated.

Automobile Equipments.—"Westinghouse Electrical Equipments for Automobiles and Garages" is the title of a small pamphlet (Folder 4223) issued by the Westinghouse Electric & Manufacturing Company. It describes the Westinghouse 6-volt, single-wire starting, lighting and ignition systems. Accessories, including meters, rectifiers, vulcanizers, etc., are also described.

Telephones.—The Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y., is sending out a large folder telling about its national publicity campaign in advertising its telephone system for offices, stores, factories and homes, and offering sales promotion service for telephone companies and contractors. Inclosed within the folder is a booklet of twenty-four pages that describes what its title indicates, "Systems That Save Business Time."

Soldering Pastes.—The M. W. Dunton Company, 65 Atlantic Avenue, Providence, R. I., has issued a poster, size 24 in. by 18 in., folded for mailing, which contains a number of illustrated practical "kinks" suggested by users of "Nokorode" soldering paste. Along the sides of the folder are illustrated the containers of the various specialties made by the company, including those of varnished cloth and tapes, soldering pastes, soldering salts, friction tape, sleeving and others.

Personal Mention

Mr. T. A. Clifton has leased and will manage the Devall Bluff (Ark.) Electric Light Company, which was formerly operated by the municipality.

Mr. H. W. Thompson has been appointed superintendent of the municipal lighting and power plant at Azusa, Cal., succeeding Mr. Charles Edwards.

Mr. Homer Rickard has resigned from the Maryville (Mo.) Electric Light & Power Company to accept the position of manager of the Hamilton (Mo.) Electric Light Company.

Mr. J. P. Butler, local manager of the Corning (Cal.) office of the Northern California Power Company, has been transferred to the Chico office as successor to Mr. F. P. Bergen, resigned.

Mr. A. H. Warren, who has been manager of the Pensacola (Fla.) Electric Company for the past five years, has been transferred to the Galveston-Houston Electric Company, Galveston, Tex.

Mr. F. P. Bergen, local manager for several years of the Chico (Butte County) office of the Northern California Power Company, has resigned to take up broader work in hydroelectric engineering.

Mr. Charles E. Campbell, designer and builder of electrical apparatus and president of the Campbell Electric Company, of Lynn, Mass., is the subject of an illustrated sketch in the Lynn *Item* of Oct. 11.

Mr. W. G. Chace, of the firm of Kerry & Chace, Ltd., formerly Smith, Kerry & Chace, of Toronto, has been appointed chief engineer of the entire construction of the Greater Winnipeg water system.

Mr. Charles R. Hosmer has been elected president of the West Kootenay Power & Light Company, Ltd., of Rossland, B. C., as successor to the late W. M. Doull. The executive offices of the company are located in Montreal, Quebec.

Mr. T. R. Robinson, superintendent of the Worcester Suburban Electric Company, of Uxbridge, Mass., has resigned. Mr. Robinson has been connected with the company for the past five years, and during his incumbency the station was entirely rebuilt.

Mr. Charles C. Marshall, of Sidney, Ohio, has been appointed by Governor Cox to succeed the late W. L. Dechant as member of the Ohio Public Utilities Commission. Mr. Marshall has been counsel for the commission and is described as a moderate, fair-minded man.

Mr. F. A. Persons, for several years superintendent of the Concord, Maynard & Hudson Street Railway Company, of Maynard, Mass., has been promoted to the superintendency of motive power and equipment of the roads controlled by the Massachusetts Consolidated Railways, with headquarters at Greenfield, Mass.

Mr. G. L. Pearson has resigned as general manager of the Central New Hampshire Power Company, of Brattleboro, Vt. In view of the recorded intention of the company to act hereafter as a holding company, no one has been apponited to succeed Mr. Pearson and the office of general manager has been abolished.

Mr. T. J. Hanlon, who at one time was connected with the Dallas (Tex.) Electric Light & Power Company and at present is superintendent of the street railway department of the Pensacola (Fla.) Electric Company, has been appointed general manager of the company as successor to Mr. A. H. Warren, who has been transferred to Galveston.

Mr. J. B. McCall, president of the Philadelphia Electric Company and also of the National Electric Light Association, has accepted membership on the jury of award for the International Exposition of Safety and Sanitation to be held under the auspices of the American Museum of Safety early in December at the Grand Central Palace, New York City.

Mr. John J. Kates, formerly commercial agent of the Key West (Fla.) Electric Company, has been appointed commercial agent of the Paducah (Ky.) Light & Power Company, succeeding Mr. H. J. Pettengill, Jr., who has been placed in charge of the commercial department of the Blackstone Valley Gas & Electric Company at Woonsocket, R. I.

Dr. Irving Langmuir, to whose research work may be attributed the recent developments in the high-efficiency tungsten lamp, was born in Brooklyn, N. Y., Jan. 31, 1881. His early education was obtained in the public schools of that city, which he attended until June, 1892, at which time his parents went to Paris, and there Dr. Langmuir studied under French teachers for three years. Returning to the United States in the fall of 1895, he entered Chestnut Hill Academy at Philadelphia, and the following year found him in Pratt Institute, Brooklyn. Entering college, Dr. Langmuir took the course in metallurgical engineering at Columbia University and was graduated in 1903 with the degree of metallurgical engineer. While at Columbia University he was interested mainly in chemistry and mathematics. After his graduation Dr. Langmuir went abroad and took up post-graduate work at the University of Göttingen, Germany, carrying on investigations on the kinetics of chemical reaction and on the dissociation of water vapor and carbon dioxide in the laboratory of Prof. Nernst. In January, 1906, the degrees of M.A. and Ph.D. were awarded to him by the University of Göttingen, his major subject having been physical chemistry. Returning to the United States the following month, he became an instructor in chemistry at the Stevens Institute of Technology, where he taught until July, 1909. After leaving Stevens Institute, Dr. Langmuir entered the research laboratory of the General Electric Company at Schenectady, since which time he has been engaged mostly in researches on tungsten lamps and also to some extent in work related to electric heating devices. Some of his work in connection with the tungsten lamp was detailed in a paper before the American Institute of Electrical Engineers on Oct. 10 and published in these columns last week. Dr. Langmuir has, however, been a frequent contributor to national scientific bodies, some of his contributions being as follows: "Thermal Conduction and Convection in Gases at Extremely High Temperatures," before the American Electrochemical Society at Toronto, Can., Sept. 22, 1911; "A Chemically Active Modification of Hydrogen," presented at the Washington meeting of the American Chemical Society in December, 1911; "Chemical Reactions at Very Low Pressures—The Clean-up of Oxygen in a Tungsten Lamp," before the New York Section of the American Chemical Society, Nov. 8, 1912; "Chemical Reactions at Very Low Pressures—The Chemical Clean-up of Nitrogen in a Tungsten Lamp," before the New York Section of the American Chemical Society, Nov. 8, 1912; "Laws of Heat Transmission in Electrical Energy," presented at the mid-winter convention of the American Institute of Electrical Engineers in New York, February, 1913, and "Conduction and Radiation of Heat," presented at the twenty-third general meeting of the American Electrochemical Society, Atlantic City, April 3, 1913.

IRVING LANGMUIR

Obituary

Robert B. Borland, superintendent of cable construction of the New York Telephone Company for the past fifteen years, died in his home at Bayonne, N. J., on Oct. 19. Mr. Borland was a graduate of Stevens Institute and of the School of Mines, Columbia University.

Charles A. Chapin, of Chicago, president of the Indiana & Michigan Electric Company, South Bend, Ind., died on Oct. 22. The company of which Mr. Chapin was the head absorbed the Charles A. Chapin Light & Power Company, Buchanan, Mich.; the South Bend (Ind.) Electric Company; the Elkhart (Ind.) Electric Company, and the Berrien Springs (Mich.) Power & Electric Company.

Construction

New England

ASHLAND, MAINE.—George H. Mooers, owner of the local electric-light plant, expects to purchase one 75-hp Rodney Hunt turbine within the next month.

MILFORD, N. H.—The Selectmen have signed a contract with the Milford Lt. & Pwr. Co. for lighting the streets of the village for a period of ten years. Under the terms of the contract the company is to replace all arc lamps with incandescent lamps at $20 each per year.

NEWPORT, N. H.—The plant and holdings of the Newport El. Lt. Co., of Newport, and the Sunapee El. Lt. Co., of Sunapee, has been purchased by the Central New Hampshire Pwr. Co., of Brattleboro, Vt. It is understood that an additional turbine will be installed in the Newport plant and the Newport system will be connected with the Claremont lines. The price paid for the properties is said to be $180,000.

WINOOSKI, VT.—The Winooski Valley Pwr. Co., a subsidiary of the American Gas Co., of Philadelphia, Pa., is building a hydroelectric power plant at Hubbles Falls, Vt. The plans provide for the development of 10,000 hp, half of which, it is said, has already been contracted for. Morris Stroud, 222 South Third Street, Philadelphia, Pa., is president of the American Gas Co.

BROCKTON, MASS.—The contract for the proposed addition of the power plant of the Edison El. Illg. Co. of Brockton, at East Bridgewater, has been awarded to the Stone & Webster Engineering Corpn., of Boston. The cost is estimated at $350,000. The work will include the erection of an addition to present plant and the installation of two additional boilers, of 600 hp each, to be fitted with automatic stokers, forced-draft fans, air ducts and ash hoppers. The four present boilers are to be similarly equipped; also the installation of a 5000-kw turbo-generator, together with a 100-kw motor-driven exciter, condensing-equipment, switchboard, etc.; coal bunkers, conveyors, traveling weight hoppers, together with crusher.

CHICOPEE, MASS.—The Electric Light Commission expects to extend its lighting system to Fairview, a part of the city heretofore without an incandescent lighting service, within the next two months. Contract for the material has already been placed.

EVERETT, MASS.—Estimates have been submitted to the Board of Trade of the cost of maintaining an ornamental street-lighting system on Broadway from the Boulevard to Glendale Square or from the Boulevard to Sumner Street. The plans provide for the erection of 69 magnetite arc lamps, to cost $8,743 per year if the wires are placed underground, or $6,849 annually if overhead wires are used.

HAVERHILL, MASS.—The State Board of Gas and Electric Light Commissioners have approved the petition of the Haverhill El. Co. to issue additional capital stock to the amount of $278,400.

TORRINGTON, CONN.—The Torrington El. Lt. Co. is contemplating replacing the 32-cp incandescent lamps now in use with 60-cp lamps.

Middle Atlantic

CLAYVILLE, N. Y.—At a special election held recently the proposition to enter into a contract with the Utica Gas & El. Co. to light the street with electricity for a period of five years, at $825 per year, was carried.

WEEDSPORT, N. Y.—The Village Council has adopted an ordinance directing the village clerk to advertise for bids for construction of a municipal electric-light plant.

WEST HAVERSTRAW, N. Y.—Bids will be received by George Blagden, president of the board of managers of the New York State Hospital for Crippled and Deformed Children, West Haverstraw, N. Y., until Oct. 29, for construction, heating, plumbing and electric work for solaria at the New York State Hospital for Crippled and Deformed Children at West Haverstraw. Bids will be received for each division of the work separately and no combination of bids will be considered. Drawings and specifications may be consulted and blank forms of proposals obtained at the New York State Hospital for Crippled and Deformed Children at West Haverstraw and at the office of Lewis F. Pilcher, state architect, Capitol.

PITTSBURGH, PA.—The Pittsburgh Railways Co. contemplates remodeling the car barn on Fifth Avenue in Oakland as a substation and laboratory of the Duquesne Lt. Co. Equipment will be installed for the distribution of electricity throughout that district of the city. The cost of the work is estimated at $75,000.

LONG BRANCH, N. J.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Nov. 23, for construction, including mechanical equipment, interior lighting fixtures and approaches, of the United States post office at Long Branch, N. J. Drawings and specifications may be obtained from the above office or from the custodian of site, at Long Branch. O. Wenderoth is supervising architect.

PARKERSBURG, W. VA.—Plans are being prepared by the Parkersburg, Marietta & Interurban Ry. Co. for the installation of an ornamental street-lighting system on Market Street. The plans provide for 90 lamps.

RALEIGH, W. VA.—The Raleigh Coal & Coke Co. is contemplating the construction of a power house (36 ft. by 36 ft.) and machine shops (40 ft. by 125 ft. and 40 ft. by 60 ft.). The company proposes to equip its plant with motors aggregating 2500 hp.

CHARLOTTESVILLE, VA.—The Redland Pwr. Co., of Charlottesville, has nearly completed the installation of a 3000-hp steam turbine power plant. Through mistake an item was published in the issue of Oct. 4 stating that the Redland Lumber Co. was contemplating the installation of an electric-light plant.

MANASSAS, VA.—N. Wilson Davis, engineer, of Harrisonburg, Va., it is reported, has been engaged by the Town Council to prepare plans and supervise the construction of an electric-light plant, sewer system and water works. Bonds to the amount of $75,000 have been voted for the proposed improvements.

WASHINGTON, D. C.—The contract for construction of lighting, heating and power system for the United States court house in Washington, D. C., has been awarded to W. G. Cornell, of Washington, at $18,930.

WASHINGTON, D. C.—Work, it is expected, will soon begin on the installation of a new street-lighting system on Pennsylvania Avenue between the Treasury Building and the Peace Monument. It is proposed to replace the 78 lamps of 700 cp now in use with 150 lamps of 1500 cp each. The contract for lamp-posts has been awarded to the Union Foundry Co. of Alabama. Plans have been prepared by Walter C. Allen, electrical engineer of the District of Columbia, providing for increased illumination in the area bounded by Pennsylvania Avenue and G Street and Fifteenth and Seventh Streets, Northwest.

North Central

BELDING, MICH.—The Spencer El. Lt. & Pwr. Co., of Belding, expects to repair within the next year headrace flume and reset waterwheels, flume and race to be of reinforced concrete, also to purchase one waterwheel of 150 hp and one waterwheel governor within the next 12 months. The company hopes to secure the city lighting contract for a term of five years, beginning June 1, 1914. Wire, poles and reflectors for 140 series tungsten lamps of 80 cp for above have been purchased. J. E. Stanton is manager. William G. Fargo is consulting engineer.

COLDWATER, MICH.—The managers of the municipal electric-light plant expect to purchase within the next eight months two water-tube boilers of from 200 hp to 300 hp and also to purchase a carload of poles within the next six months. William H. Friedrich is superintendent.

HIGHLAND PARK, MICH.—Bids will be received at the office of the village clerk, 20 Gerald Avenue, Highland Park, until Nov. 3 for furnishing labor and material for the construction of an ornamental street-lighting system, consisting of 61 standards for five-lamp clusters and 20,000 ft. of twin conductor, No. 4 cable. Plans and specifications are on file at the office of L. D. Beckley, superintendent of public works, 28 Gerald Avenue.

SAULT STE. MARIE, MICH.—Applications have been made to the International Joint Commission in Ottawa, Ont., by the Michigan & Lake Superior Pwr. Co., of Sault Ste. Marie, Mich., and the Algoma Steel Corpn., of Sault Ste. Marie, Ont., for permission to divert the water at Sault Ste. Marie. The companies propose to build a dam from each side of the international boundary, which will meet in the center.

AKRON, OHIO.—Bids will be received by R. M. Pillmore, director of public service, Akron, Ohio, until Oct. 29 for furnishing and erecting pumping machinery and equipment, including one motor-driven high-lift centrifugal pumping unit (3,000,000 gal. capacity), one combined steam-turbine and motor-driven low-lift centrifugal pumping unit (12,000,000 gal. capacity), one steam-turbine-driven generator unit, switchboard transformers, wiring and accessories. Plans and specifications may be seen at the office of the director or at the office of F. A. Barbour, engineer, 1120 Tremont Building, Boston, Mass.

CALDWELL, OHIO.—Bids will be received by the village clerk of Caldwell until Nov. 5 for the purchase of $8,000 in bonds, the proceeds of which will be used for extensions and improvements to the municipal electric-light plant and water-works system. Harry A. Smith is village clerk.

CAMBRIDGE, OHIO.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Nov. 28 for the construction, complete, including mechanical equipment, interior lighting fixtures and approaches, of the United States post office at Cambridge, Ohio. Drawings and specifications may be obtained after Oct. 20 from the above office or from the custodian of site at Cambridge. O. Wenderoth is supervising architect.

FINDLAY, OHIO.—The proposition to issue $57,000 in bonds for the purpose of installing a municipal distribution system for the purpose of distribution of electrical energy for municipal, industrial and domestic uses will be submitted to the voters at the general election to be held Nov. 4.

MAUMEE, OHIO.—The State Utilities Commission has granted the Valley Lt. & Pwr. Co., of Maumee, authority to borrow money on its recent issue of $49,000 first mortgage bonds, which could not be sold advantageously. The sum to be borrowed must not be less than 80 per cent of the par value of the bonds.

ST. PARIS, OHIO.—The managers of the municipal electric-light plant expect to purchase within the next two months one set of Loco shaking grates and one 6-in. by 4-in. by 6-in. duplex boiler-feed pump. John C. Phelps is superintendent.

FULTON, KY.—We are informed that the Fulton El. Lt. & Pwr. Co. has practically completed the installation of additional equipment in its plant, changing from 133-cycle alternating current and 220-volt direct current to a 60-cycle system, also doubling the output of the plant. The company expects to remodel its power house, making it fireproof. A. D. Brinkerhoff is secretary and treasurer of the National Lt. & Pwr. Co., of St. Louis, which controls the Fulton company.

GRAYSON SPRINGS, KY.—The Grayson Spring Hotel Co. has awarded a contract to the Falls City Construction Co., of Louisville, to design and build a hotel plant, to cost about $400,000. An electric light and power plant will be installed in connection with the hotel.

MOREHEAD, KY.—The managers of the municipal electric-light plant are contemplating the installation of a 50-hp oil engine and discarding the present steam engine and boiler. E. E. Maggard is manager.

OWENTON, KY.—The town of Owenton has granted W. English Arnold a franchise to construct and operate an electric street-lighting system here. Mr. Arnold will install electrical equipment in connection with his flour mill in Owenton.

RICHMOND, KY.—The Dix River Pwr. Co. has recently filed deeds for land along the river to be used in connection with its proposed power plant, to be erected on the river near Richmond. The proposed plant will have sufficient output to furnish energy to many of the larger cities in central Kentucky. L. B. Herrington, of Richmond, is president.

ELWOOD, IND.—The Indiana General Ser. Co., of Elwood, is completing the rebuilding of its steam generating plant at Elwood and the converting of the Alexandria plant into a substation and residence combined. It has also built an outdoor substation at Orestes, supplying energy from its high-tension line in that locality. N. M. Argabrite is manager.

UNION CITY, IND.—The Union City El. Co. expects to purchase within the next two or three months several thousand feet of steel-taped cable for connecting ornamental street lamp standards and from 50 to 75 ornamental boulevard lamp-posts for lighting the main streets of Union City. D. O. Vaughn is manager.

BARRY, ILL.—The Central Illinois Pub. Ser. Co., of Mattoon, expects to erect within the next four months about 35 miles of transmission line from the Illinois River at Valley City to Hull Station, connecting with the transmission lines from the Keokuk power plant at the latter place. W. G. Printy is local superintendent.

BUFFALO, ILL.—The Central Illinois El. Co., of Buffalo, is contemplating the purchase of equipment for 16,500-volt transmission line 20 miles long. George B. Conover is president.

MADISON, WIS.—Plans are being prepared by the City Council and the Capitol Building Commission for the installation of an ornamental lighting system for lighting the Capitol Park and surrounding streets. The plans provide for the erection of 60 ornamental standards in the park. The cost of the system is estimated at about $25,000, of which about $10,000 will be paid by the State.

MELLEN, WIS.—The Mellen Wtr. & Lt. Co. would like to receive information pertaining to oil engines and producer gas engines and also on tungsten street-lighting systems. A. W. Pribnow is president and general manager.

MENOMONEE FALLS, WIS.—The plant and holdings of the Menomonee Falls Lt. & Pwr. Co. have been purchased by J. A. Pratt, of Menomonee Falls, and William C. Leitzke, of Wausau. The new company will be known as the Menomonee Falls El. Lt. & Pwr. Co., and will install a new power plant. It proposes to furnish electricity to surrounding towns and villages as well as in this city.

MILWAUKEE, WIS.—The Wisconsin Railroad Commission has authorized the Wells Pwr. Co., of Milwaukee, to issue $136,000 in capital stock and $35,000 in notes. The company is further authorized to issue $265,000 in 6 per cent notes, to be sold for not less than 75, the proceeds of $190,000 to be used to retire outstanding indebtedness and $75,000 to be used for extensions and improvements to its plant and property.

BEMIDJI, MINN.—Within the next 30 days the Warfield El. Co., of Bemidji, expects to purchase one carload of poles. A. A. Warfield is secretary.

DULUTH, MINN.—The contract for construction of the new dam at Thomson for the Great Northern Pwr. Co., of Duluth, has been awarded. It is understood that contracts for the installation of an additional motor set at Thomson will soon be awarded. The cost of the proposed improvements is estimated at $300,000. The company is also contemplating extensions to its power system on the Mesaba and Cuyana ranges, for which preliminary surveys have been made. J. B. Crane, of Duluth, is contract agent.

FERGUS FALLS, MINN.—The City Council has voted to install an ornamental street-lighting system, to cost about $4,500.

McKINLEY, MINN.—The Village Council has entered into a contract with the St. Louis Pwr. Co. for electricity to operate the municipal electric-light system.

WALKER, MINN.—Bids will be received by the State Board of Control, State Capitol Building, St. Paul, until Nov. 5 for construction and completion of service building, plumbing, wing, power plant, laundry, recreation building and children's pavilion at the State Sanatorium, Walker, Minn., including general contract work, heating and ventilating, plumbing and electrical work, in accordance with plans and specifications furnished by C. H. Johnston, architect, 715 Capitol Bank Building, St. Paul. Bids will be received collectively and separately. Copies of plans and specifications may be seen at the Builders' Exchanges in St. Paul and Minneapolis, at the office of the superintendent at the institution at Walker, and at the office of the State Board of Control, State Capitol Building, St. Paul. Extra copies of plans and specifications may be obtained on application to the architect on payment of cost of duplication of same.

WINONA, MINN.—Bids will be received by the State Board of Control, State Capitol Building, St. Paul, until Nov. 5 for the construction and completion of the model school building at the State Normal School, Winona, including the general contract work, heating and ventilating, plumbing and electrical work, in accordance with plans and specifications furnished by C. H. Johnston, architect, 715 Capitol Bank Building, St. Paul, Minn. Bids will be received collectively and separately. Copies of plans and specifications may be seen at the Builders' Exchanges in St. Paul and Minneapolis, and at the office of the president of the State Board of Control, State Capitol Building, St. Paul. Extra copies may be obtained on application to the architect upon payment of the cost of duplication.

AMES, IA.—The Electric Light and Water Department expects to erect within the next six months a 500-kw Curtis turbine and Westinghouse Le Blanc condenser in the municipal electric light plant, and to purchase generating panel with instruments and switches. Charles E. Warsaw is manager.

DES MOINES, IA.—The Des Moines El. Co. is contemplating the installation of a central heating plant to serve the downtown district. The cost of the plant is estimated at $250,000.

EDGEWOOD, IA.—Bonds to the amount of $12,000 have been voted for the installation of a municipal electric-light plant.

GLIDDEN, IA.—At an election held recently the proposition to issue $10,000 in bonds for extensions to the municipal electric-light plant was carried.

SUMNER, IA.—The Sumner El. Lt. Co. expects to purchase within the next four months one 20-hp or 25-hp oil engine. C. V. Stewart is superintendent.

CAINESVILLE, MO.—The Missouri El. Gas & Wtr. Co., of Cainesville, expects to purchase within the next 30 days 20,000 ft. of No. 4 insulated copper wire (new code). L. J. Beauregard is superintendent.

GILLIAM, MO.—The Gilliam El. Lt. & Pwr. Co. would like to exchange a 50-hp Weber gas producer outfit for a 20-hp oil engine. W. R. Burton is president.

FARGO, N. D.—Bids will be received by A. R. Watkins, city auditor, Fargo, until Oct. 29 for furnishing material and erecting an ornamental street-lighting system, extending on Eighth Street from First Avenue to Front Street; on Front Street from Eighth to Tenth Street, and on Broadway from Fourth to Fifth Avenue North, in accordance with plans and specifications now on file in the office of the city auditor.

BLAIR, NEB.—At an election held recently the proposition to issue bonds for an electric-light plant and extensions to water-works system was carried.

GRETNA, NEB.—The town of Gretna has granted the McKinley interests a franchise to furnish electrical service here for a period of 50 years. Electricity for operating the system will be transmitted from Papillon. Springfield, Ralston, Richfield and Louisville will be supplied from the same circuit.

HOOPER, NEB.—H. G. Meyer, receiver for the local electric-light plant, expects to make some repairs to the distribution system and to purchase about 200 lamps within the next three months.

WICHITA, KAN.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Nov. 3 for the removal of the present elevator and the installation complete of an electric passenger elevator in the United States court house and post office at Wichita, in accordance with plans and specifications, copies of which may be obtained at the above office. O. Wenderoth is supervising architect.

WILSON, KAN.—The Wilson El. Lt. Co. expects to purchase within the next 30 days material for an ornamental street-lighting system, consisting of ornamental poles and a series of street-lighting regulators.

Southern States

HIGH SPRINGS, N. C.—The installation of a hydroelectric power plant on the French Broad River is contemplated by James E. Rector, of Asheville, N. C., and associates. The promoters are prepared to correspond with contractors and manufacturers relative to construction of dam, hydraulic equipment, electrical machinery, etc.

WILSON, N. C.—Bids will be received by the Board of Public Works until Nov. 4 for water-tube boilers, two 500-kw engine or

turbine-driven units, condenser and switchboard. Specifications and bidding forms will be mailed upon application to Gilbert C. White, engineer, Charlotte, N. C., or to the office of the chairman of Board of Public Works, Wilson, N. C. D. S. Boykin is chairman.

CHARLESTON, S. C.—The Isle of Palms Development Co., it is reported, is contemplating the installation of an electric cable under Cooper River from the foot of Charlotte Street to carhouse at Mount Pleasant for the purpose of furnishing electricity to Mount Pleasant, Sullivan's Island and Isle of Palms. The proposed cable will be about 6000 ft. long and will cost about $66,000.

AUGUSTA, GA.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Dec. 3 for the construction, complete, including mechanical equipment, interior lighting fixtures and approaches, of the United States post office and court house at Augusta, Ga. Drawings and specifications may be obtained from the above office or from the custodian of site at Augusta. O. Wenderoth is supervising architect.

BRUNSWICK, GA.—The installation of an ornamental street-lighting system on Newcastle Street is under consideration. The Board of Trade is interested in the project.

CORNELIA, GA.—The Wofford Shoals Lt. & Pwr. Co., of Cornelia, expects to erect within the next six months an auxiliary plant in the town of Cornelia, and to purchase equipment for same, consisting of a 100-kw, three-phase, 60-cycle, 2300-volt generator, a kerosene-oil engine (four-cylinder type preferred), with kerosene-oil producer equipment, switchboard equipment necessary for paralleling above generator with water-power plant of same rating. J. A. Wells is secretary and treasurer.

ATLANTIC BEACH, FLA.—Preparations, it is reported, are being made by the Atlantic Beach Corpn. for the installation of a street-lighting system, covering about 3 miles of streets. Ornamental street lamps are to be erected along the boardwalk and streets as they are opened. E. R. Brackett is president of the corporation.

DE LAND, FLA.—The De Land El. Lt., Pwr. & Ice Co. expects to purchase two car loads of 40-ft., 50-ft. and 60-ft. (6-in. top) cedar poles. E. L. Hon is manager.

MAYO, FLA.—The proposition to issue $15,000 in bonds for the installation of a municipal electric-light plant will be submitted to the voters.

PULASKI, TENN.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Nov. 29 for construction, including mechanical equipment, interior lighting fixtures and approaches, of United States post office at Pulaski, Tenn. Drawings and specifications may be obtained at the above office or from the custodian of site at Pulaski. O. Wenderoth is supervising architect.

BREWTON, ALA.—The managers of the municipal electric-light plant expect to make extensive improvements to the municipal electric-light plant and water-works system and to purchase new equipment for power house, including a 150-kw generator set and two pumps having a rating of 1000 gal. per minute within the next three months. J. S. Bannon is superintendent.

COLUMBIA, ALA.—The Columbia Pwr. Co. expects to install an additional water wheel (175 hp); also tungsten street-lighting system for the city of Columbia. C. P. Townsend, Jr., is proprietor.

BOONEVILLE, MISS.—The Booneville Wtr. Wks. Co. expects to erect within six months a series street-lighting system; also to purchase a 50-kw or 60-kw, three-phase, 60-cycle generator, 200 meters and some transformers.

MURFREESBORO, ARK.—J. Bickley and associates, it is reported, have been granted a franchise to install and operate an electric-light and power plant in Murfreesboro.

CROWLEY, LA.—The city of Crowley expects to purchase within the next three months a 180-hp oil-burning engine for the municipal electric-light plant.

NEW ORLEANS, LA.—Plans, it is reported, are being prepared by Leon C. Weiss, of New Orleans, for the construction of a power house, etc., for the Kenner-New Orleans Interurban Railway Co.

WELSH, LA.—Bids will be received by the Mayor of the town of Welsh until Nov. 3 for furnishing materials and equipment and construction of proposed new municipal electric-light plant, consisting of engines, generators, switchboard, street series regulators, poles, cross-arms, wire, arresters, street hoods, transformers, etc. Bids will be considered as a whole or on individual items. Plans and specifications may be obtained upon application to Anderson Offutt, consulting engineer, 439 Carondolet Street, New Orleans, La.

BOKHOMA, OKLA.—The Wilson Lumber Co. is planning to install a steam power plant in Bokhoma. The equipment, with the exception of engines and boilers, has not yet been decided upon.

MARIETTA, OKLA.—Bids will be received by the city clerk, Marietta, until Nov. 3 for extensions to the municipal water-works and sewer systems and electric-light plant as follows: For construction of approximately 10,000 ft. of 4-in. cast-iron water pipe, 10 hydrants and six valves; approximately 11,000 ft. of 6-in., 8-in. and 10-in. vitrified sewer pipe in place; 18 manholes, 12 flush tanks, seven lamp-holes and brick power house 40 ft. by 92 ft. The city will also purchase direct a 100,000-gal. tower and tank, 125 ft. high; one 225-hp, four-valve engine (200 r.p.m.); one 150-kva generator with exciter (200 r.p.m.); one standard switchboard panel, miscellaneous electrical instruments; one deep-well pump, having a capacity of 100 gal. per minute, and a 15-hp motor; one 300-hp feed-water heater and one boiler-feed pump. Plans and specifications may be procured at the office of the Benham Engineering Co., consulting engineer, 435-437 American National Bank Building, Oklahoma City, Okla. Bonds to the amount of $35,000 have been issued for the above work.

NORMAN, OKLA.—Contract has been awarded by the University of Oklahoma for the erection of a central power plant, consisting of building (65 ft. by 73 ft.), concrete smokestack 100 ft. high, to be built 25 ft. higher if necessary; 12-in. steam pipes in concrete tunnels covered by concrete sidewalks; 2000 ft. of tunneling and three boilers, to the Holmboe Construction Co., at $41,640.

VALLIANT, OKLA.—Plans are being considered, it is reported, to organize a stock company for the purpose of establishing and maintaining an electric-light plant in Valliant.

COLORADO, TEX.—The Texas Pwr. & Lt. Co., of Dallas, has purchased the plant and holdings of the Colorado El. Lt. & Pwr. Co.

CUERO, TEX.—The City Council has granted the Cuero Lt. & Pwr. Co. a new franchise for a period of 50 years. The company is contemplating the construction of a new dam and power house several miles below the present dam; also a large steam power plant in the city for use in case of high water. The installation of a new street-lighting system is also under consideration.

PORT ARTHUR, TEX.—The Men's Civic League, it is reported, has adopted definite plans for the installation of an ornamental street-lighting system on Proctor Street.

Pacific States

PUYALLUP, WASH.—The City Council has authorized the light committee of the Council to engage an electrical engineer to prepare estimates of the cost of erecting an electrical distribution system in Puyallup. Propositions for furnishing electricity for operating the proposed system have been submitted by the managers of the Tacoma municipal electric-light plant and the Stone & Webster Corpn.

SEATTLE, WASH.—Bids will be received by the Port Commission, 843 Central Building, Seattle, Wash., until Oct. 29 for the installation of light and power wiring systems for what is known as the central waterfront improvement of the port of Seattle. Plans and specifications are on file in the office of the Port Commission. C. E. Remsberg is secretary.

SEATTLE, WASH.—Bids will be received by the Port Commission, 843 Central Building, Seattle, Wash., until Oct. 29 for the installation of a lighting system for the east waterway improvement of the port of Seattle. Plans and specifications are on file in the office of the Port Commission, C. E. Remsberg is secretary.

SPOKANE, WASH.—The Nixon-Kimmel Co., of Spokane, expects to erect within the next two months a 11,000-volt, 60-cycle transmission line between Umatilla and Echo, Ore., a distance of 20 miles. George Nixon is president.

TACOMA, WASH.—The City Council has recently appropriated $12,000 from the light fund for the erection of an auxiliary transmission line between the Nisqually municipal power plant and the city substation. Work on the erection of the proposed line will soon be started.

ALBANY, ORE.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Nov. 26 for construction complete, including mechanical equipment, interior lighting fixtures and approaches, of the United States post office at Albany, Ore. Drawings and specifications may be obtained from the above office or from the custodian of site at Albany. O. Wenderoth is supervising architect.

CARLTON, ORE.—The City Council has granted the Yamhill El. Co. of Newberg, a franchise to construct an electric-light system in Carlton for a period of 25 years. Work will begin at once on the erection of a transmission line from the hydroelectric plant in Newberg. A 24-hour service will be established.

EUGENE, ORE.—The installation of an ornamental street-lighting system on Olive Street has been authorized by the City Council. Bids for material and installation of same will soon be asked.

KLAMATH FALLS, ORE.—The Pringle Falls El. Pwr. & Wtr. Co., of Klamath Falls, contemplates the construction of a large power plant, to be located 6 miles west of here. A small power plant and lumber mill will be erected at once and will be operated while the large power station is being built. M. C. Donahue, of Klamath Falls, is president.

WHEELER, ORE.—The City Council has granted a franchise to the Wheeler Lumber Co. to install and operate an electric-lighting system in Wheeler. Work will begin at once on the installation of a distributing system.

AZUSA, CAL.—The managers of the municipal electric-light plant expect to rebuild the entire system within the next six months to comply with the state law, provided the proposed bond issue is sanctioned at the forthcoming election. H. W. Thompson is superintendent.

BIGGS, CAL.—The Oro El. Corpn., of Oroville, has been granted permission to furnish electricity to the California Rice Milling Co. in the city of Biggs.

LOS ANGELES, CAL.—A water-power permit has been issued by the Department of Agriculture at Washington, granting rights to the Pacific Lt. & Pwr. Co., of Los Angeles, to operate power plants in the Sierra national forest. The company will transmit electrical energy at 150,000 volts to Los Angeles, a distance of 240 miles. This permit allows 12 years for construction. The present plans provide for the construction of four power houses, two reservoirs and 25 miles of cement line tunnels. Part of the energy developed will be used for pumping water for irrigation purposes in the upper San Joaquin Valley. Energy will be transmitted over a double steel tower line on aluminum cable.

LOS ANGELES, CAL.—The contract for general construction of a 12-story hotel building (brick and steel construction), to be erected at the corner of Fifth and Main Streets, has been awarded to the F. O. Engstrom Co., Fifth and Seaton Streets, Los Angeles, for Hart Brothers, at $350,000. The Machinery & Electrical Co., 351 North Main Street, Los Angeles, was awarded the contract for power plant, including furnishing and installing boilers, stacks and connections, engines, generators and switchboards, hot-water heater, heating and ventilation, foundations, supports and all appliances and apparatus for engine nd boiler equipment, at $74,935. Parkinson & Bergstrom, Security Building, Los Angeles, are architects.

SUTTER CREEK, CAL.—The State Railroad Commission has granted the Amador El. Lt. & Pwr. Co., of Sutter Creek, permission to issue $12,000 in bonds and 3000 shares of capital stock.

BOISE, IDAHO.—Preliminary steps have been taken by the City Council toward the construction of a municipal electric-light plant and water-works system. The city engineer has been instructed to secure data on a gravity water system and the Mayor has been authorized by the Council to take up with the federal government the proposition of acquiring power from the Arrow Rock River to generate electricity for lighting purposes.

SAFFORD, ARIZ.—The Gila Valley El., Gas & Wtr. Co. is reported to have been awarded a contract to construct an electric-light plant in Safford.

GLENDIVE, MONT.—The Glendive Ht., Lt. & Pwr. Co. expects to purchase 50 luminous-arc lamps with necessary equipment for ornamental street-lighting system. Frank C. Hughes is manager.

HELENA, MONT.—The Standard Engineering Co., Colma Building, Seattle, Wash., has applied to the City Council for a franchise to operate an electric light and power plant in Helena.

CONEJOS, COL.—The Conejos Co-operative Roller Mills & Mfg. Co. expects to purchase within the next four months one overshot waterwheel to operate under a 22-ft. head (48 second ft. of water). John Crawford is electrician.

PITKIN, COL.—The Brant Independent Mining Co., of Pitkin, is contemplating the installation of a hydroelectric power plant to furnish electrical energy for operating its mine and also to the towns of Pitkin and Ohio City. The proposed plant will be erected on Quarts Creek, where a dam and a flume is now being built to carry the water to the power plant. The present plans provide for the development of 600 hp.

Canada

VANCOUVER, B. C.—The Dominion government has instructed H. A. Gasham, marine surveyor, to take soundings in Nodalles, Okis and Cardero channels, separating Valdez and Thurlo Island and the mainland, preceding the laying of 115 miles of telephone lines.

NEEPAWA, MAN.—The by-law authorizing an expenditure of $18,000 for extensions to the municipal electric-light system was passed recently.

TRANSCONA, MAN.—Tenders will be received by P. E. Ryan, secretary of the Commissioners of the Transcontinental Railway, at the office of the Transcontinental Railway, Ottawa, Ont., until Nov. 4 for furnishing and installing electric wiring systems required in connection with the equipment of the Transcontinental Railway car shops at Transcona, Man., about 6 miles east of Winnipeg. Plans may be seen and forms of tenders and specifications obtained at the office of W. J. Press, mechanical engineer, Ottawa, Ont., and at the office of H. H. Pinch, assistant engineer, Transcona.

FERGUS, ONT.—The Hydro-Electric Power Commission is planning to furnish energy to the towns of Fergus and Elora, the transmission line to be extended from Guelph. The cost of installing the local system in each town is estimated at $10,000.

HAMILTON, ONT.—The Hamilton By-Product Coke Ovens, Ltd., recently incorporated with a capital stock of $1,000,000, will erect a plant for manufacturing coke for smelting, foundry, industrial and domestic uses. The plant will be equipped for electrical operation and will use between 700 hp and 1000 hp per day. P. V. Burns, of the Ontario Pipe Line Co., and John G. Gauld, of Nesbit, are interested in the project.

NIAGARA FALLS, ONT.—The Ontario Pwr. Co., it is reported, is contemplating utilizing the waters of Chippewa Creek for generating electrical energy, if the project on foot to install a lock in the creek below Lyon's Creek in connection with canal system materializes.

OWEN SOUND, ONT.—The Council will soon close a contract with the Hydro-Electric Power Commission of Ontario for the development of Eugenia Falls on Beaver River. It is estimated that the falls can supply 1400 hp without storage and 4000 hp with storage facilities. The requirement of Owen Sound at the present time would not exceed 800 hp, for which a rate of $31 per hp has been quoted by the commission.

PORT HOPE, ONT.—Plans have been prepared by the Port Hope El. Lt. & Pwr. Co. for the installation of an electric street-lighting system in Port Hope, to cost about $13,000. The plans provide for the installation of 355 tungsten lamps of 60 cp, erection of 34 concrete posts and the remainder wooden poles. The contract for installation of the system has been awarded to the Midland Construction Co. of Toronto.

ST. CATHARINES, ONT.—A by-law authorizing an expenditure of $116,000 for the construction of a substation and distribution system for electricity to be supplied by the Hydro-Electric Power Commission of Ontario will be submitted to the ratepayers on Oct. 30.

TORONTO, ONT.—Plans have been submitted to the city engineer by the Toronto El. Lt. Co. for removing its overhead lines and placing its wires in underground conduits in the area between Wellesley Street and the waterfront bounded by Sherborne Street and Spadina Avenue. The cost of the work is estimated at about $2,000,000.

WINDSOR, ONT.—The Sandwich, Windsor & Amherstburg Ry. Co., of Windsor, has recently placed orders for additional switchboard equipment and for 50 meters. James Anderson is general manager.

CHARLOTTETOWN, P. E. I.—The City Council has passed a resolution offering to purchase the plant of the Charlottetown Lt. & Pwr. Co., to be owned and operated by the municipality. The price suggested is $96,000.

HULL, QUE.—The Hull El. Co. expects to erect within the next two months two 800-kva transformers and to purchase four closed single-end trailer cars within the next three months. Gordon Gale is general superintendent.

ST. JEROME, QUE.—Contracts for material and construction of the municipal electric-light plant have been awarded and the work is nearing completion. The equipment of the plant will consist of two 270-hp twin horizontal, open-flume-type Allis-Chalmers-Bullock waterwheels (277 r.p.m. under a 20-ft. head); Bell Switzerland oil-pressure-type waterwheel governors; two 150-kw, 60-cycle, 6600-volt Allis-Chalmers-Bullock generators; two switchboards, Weston instruments, Condit three-pole, single-throw oil switches, three 100-kva, single-phase, 6600-2200-volt Allis-Chalmers-Bullock transformers. The Canadian Allis-Chalmers Co. has the contract for the entire electrical equipment. S. D. Sweetnam, of Montreal, Que., is consulting engineer. E. M. Marchand is secretary and treasurer of town of St. Jerome.

Miscellaneous

SANTIAGO, CUBA.—The Cia Electrica de Alumbrado y Traccion de Santiago expects to erect within the next 18 months a substation with an output of 600 kva, to be equipped with one synchronous motor-generator set to furnish energy for transmission at 2300 volts, three-phase, to 600-volt direct-current for tramway; also to purchase within the next 18 months automatic stokers for nine Babcock & Wilcox boilers, one new open feed-water heater with meter; also flow meters for nine boilers; also material for 12 miles of 2300-volt, three-phase transmission line, equal amount of 0000 trolley wire and feeder cables. Within the next 24 months the company expects to purchase one additional 1000-kw, 2300-volt turbo-generator and one 500-kw synchronous motor-generator set, switchboard equipment, including turbine panel, motor-generator panels and additional alternating-current and direct-current feeder panels to be added to the present switchboard. M. B. Puente is general manager.

HILO, HAWAII.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Jan. 15, 1914, for construction complete, including mechanical equipment and approaches, of United States post office, custom house and court house at Hilo, Hawaii. Drawings and specifications may be obtained at the above office, at the office of Henry D. Whitfield, architect, 160 Fifth Avenue, New York, N. Y., or from the custodian of the site at Hilo, Hawaii. O. Wenderoth is supervising architect.

New Incorporations

MOOERS, N. Y.—The Mooers El. Lt. Co. has been incorporated with a capital stock of $5,000 by H. W. Knapp, Minnie L. Knapp and T. E. Filmore, all of Mooers.

COSHOCTON, OHIO.—The Ohio Service Co. has been incorporated by Frank E. Pomerene, Robert G. Thompson, K. K. Garrett, H. S. Lebarger and L. A. Smith. The company is capitalized at $30,000 and proposes to generate and distribute electricity.

STRANG, OKLA.—The Grand River Pwr. & El. Co. has been incorporated with a capital stock of $5,000 by H. C. Holderman, E. L. Stegall and Maude A. Holderman. Post office address is Lynch.

WHITE SULPHUR SPRINGS, W. VA.—The Allegheny Pwr. Co. has been chartered with a capital stock of $25,000. The incorporators are: A. E. Huddleston, Edward M. Haynes and others.

SALABERRY, QUE., CAN.—The Valley Field Wtr. Pwr. Co. has been incorporated with a capital stock of $1,000,000.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED OCT. 14, 1913.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York.]

1,075,362. ELECTROLYTIC CELL; C. W. Marsh, Greenwich, Conn. App. filed April 10, 1911. Diaphragm type intended for decomposition of chlorides of sodium and potassium.

1,075,363. ELECTROLYTIC CELL; C. W. Marsh, Greenwich, Conn. App. filed Jan. 15, 1912. Diaphragm type for electrolysis of alkali-metal chlorides.

1,075,364. ELECTROLYTIC CELL; C. W. Marsh, Greenwich, Conn. App. filed Jan. 15, 1912. Has pervious cathode and diaphragm flexed to provide recesses communicating with the anode compartment.

1,075,365. ELECTRIC LAMP ATTACHMENT; W. P. McNeel, San Antonio, Tex. App. filed April 23, 1912. Lamp-dimming switch attachment.

1,075,402. VAPOR-ELECTRIC DEVICE; F. P. Coffin, Schenectady, N. Y. App. filed Jan. 25, 1913. Rectifier with cathode chamber insulated from the main arc chamber.

1,075,404. IMPEDANCE DEVICE FOR USE WITH CURRENT RECTIFIERS; F. Conrad, Swissvale, and Y. Sakai, East Pittsburgh, Pa. App. filed Jan. 10, 1912. By which rectifier may be caused automatically to charge widely varying numbers of cells of storage battery.

1,075,421. ELECTRIC SIGNALING SYSTEM; R. M. Hopkins, New York, N. Y. App. filed Jan. 27, 1913. Current of minimum strength normally maintained in the signal circuit is increased sufficiently to operate the signal instrument.

1,075,423. TELEPHONE HAND SET; R. R. Ireland and A. F. F. Gilson, East Orange, N. J., and Closter, N. J. App. filed April 1, 1913. Supporting member with the transmitter properly positioned at one end and the receiver at the other end, and with the switch mechanism housed intermediate to the ends.

1,075,430. TELEPHONE EXCHANGE SYSTEM; F. R. McBerty, New Rochelle, N. Y. App. filed July 23, 1910. Automatic selectors whereby various kinds of lines, such as ordinary and private branch exchange lines, may be interconnected.

1,075,436. ELECTRIC HEATER; W. O. Peale, Pittsburgh, Pa. App. filed March 13, 1911. "Batch heaters" for candy making; plurality of heater units one above the other, with a reflector for each unit.

1,075,441. ELECTROMAGNETIC RETAINING DEVICE; G. Rekers, Rochester, N. Y. App. filed March 31, 1911. Overcomes liability of retaining device becoming "locked" in retaining position when the energizing current ceases.

1,075,445. CONTROLLER FOR ELECTRIC MOTORS; H. A. Steen, Pittsburgh, Pa. App. filed Jan. 3, 1910. Contact arm moved rapidly from one point to the next, and at same time a time element is introduced whereby motor is gradually accelerated.

1,075,452. DYNAMO-ELECTRIC MACHINE; H. Weichsel and S. T. Webster, St. Louis, Mo. App. filed June 15, 1912. For starting gas engine from a storage battery and serving as generator when motor is running.

1,075,462. SYSTEM OF TRAIN CONTROL; J. L. Crouse, Pittsburgh, Pa. App. filed Dec. 21, 1910. Controls the two locomotives on a train concurrently through the releasing of the air brakes on the forward engine.

1,075,463. LAMP SOCKET; J. Darby, Summit, N. J. App. filed March 12, 1910. Pull socket with special pawl and ratchet-operating mechanism.

1,075,470. RAILWAY-MOTOR VENTILATION; J. D. Forrer, Pittsburgh, Pa. App. filed Sept. 12, 1910. Introduces the cooling air through the gear case.

1,075,472. ELECTRICALLY HEATED STOVE UNIT; W. S. Hadaway, Jr., East Orange, N. J. App. filed June 28, 1909. Lids of different heating capacity which may be applied to the same stove base.

1,075,473. ELECTRIC SOLDERING IRON; W. S. Hadaway, Jr., East Orange, N. J. App. filed April 10, 1911. Incased tubular heater which fits snugly into tapered receiving member.

1,075,475. INCANDESCENT LAMP; R. H. Henderson, East Orange, N. J. App. filed Feb. 3, 1911. Provides a guard for the hook which supports the filament and after applying the filament removes the guard.

1,075,479. GALVANIC CELL; M. L. Kaplan, Brooklyn, N. Y. App. filed May 20, 1913. Contains sesquihydrated manganese peroxide as a depolarizing agent.

1,075,484. ARC-LAMP ELECTRODE; G. M. Little, Pittsburgh, Pa. App. filed Jan. 5, 1907. Contains iron oxide and potassium silicate.

1,075,485. TELEPHONE PAY STATION; G. A. Long, Hartford, Conn. App. filed Feb. 19, 1912. Prevents operation of signal until toll for the message has been paid.

1,075,497. ELECTRIC SOLDERING IRON; E. E. Rose, Pittsburgh, Pa. App. filed April 10, 1911. Tapered soldering tip frictionally held in tapered sleeve within the heater unit.

1,075,502. COMMUTATOR FOR DYNAMO-ELECTRIC MACHINES; T. S. Scott, Pittsburgh, Pa. App. filed Dec. 14, 1908. Clamping rings for the commutator segments consisting of convolutions of steel wire.

1,075,503. TELEGRAPH TRANSMITTER; C. E. Scribner, Jericho, Vt. App. filed Sept. 8, 1911. Printing telegraph transmitter for system with two main-line conductors and ground return.

1,075,504. TELEGRAPH TRANSMITTER; C. E. Scribner, Jericho, Vt. App. filed Nov. 28, 1911. Transmitter capable of sending plurality of characteristic impulses, with a controlling relay for each characteristic impulse.

1,075,517. ELECTRICAL HEATER ELEMENT AND METHOD OF MAKING THE SAME; H. B. Taylor, Wilkinsburg, Pa. App. filed Oct. 13, 1909. Threads insulated conductor through metal tube and then subjects assembled parts to high pressure.

1,075,539. CASING FOR INCANDESCENT ELECTRIC-LAMP SOCKETS; C. H. Bissell, Syracuse, N. Y. App. filed Feb. 18, 1911. Multiple lock between shell and cap.

1,075,542. TRAIN ANNUNCIATOR; S. C. Bryant, Chicago, Ill. App. filed, March 3, 1911. To notify operator in a signal tower of the approach of a train.

1,075,556. BATTERY; W. H. Fenoughty, Belleville, Ill. App. filed May 12, 1913. Casing with springs which make the proper connections by the simple insertion of the cells into the casing.

1,075,563. METAL FILAMENTS; C. A. Hansen, Schenectady, N. Y. App. filed July 9, 1906. Squirtable mixture consisting of an oxide of tungsten, starch, glycerine and glucose.

1,075,570. ELECTROLYTIC CELL; A. H. Hooker, Niagara Falls, N. Y. App. filed Feb. 26, 1912. High-amperage cell for the electrolysis of alkali-chloride solutions.

1,075,573. TRANSFORMER BUSHING AND TERMINAL BOARD; S. E. Johannesen, Pittsfield, Mass. App. filed Feb. 6, 1912. Terminal board having a bushing adapted to project through the wall of the transformer casing.

1,075,579. MOTOR STARTER; C. D. Knight, Schenectady, N. Y. App. filed Nov. 12, 1908. Resistance in secondary circuit may be automatically reinserted in the secondary circuit upon opening of the primary circuit; primary circuit cannot be closed until said resistance is inserted in the secondary circuit.

1,075,609. ELECTROLYTIC CELL; G. W. Stone, Niagara Falls, N. Y. App. filed March 6, 1911. Anode chamber with non-pervious interior facing; separable cathode chambers.

1,075,612. MEANS FOR FASTENING ELECTRIC LAMP SOCKETS; W. C. Tregoning, Cleveland, Ohio. App. filed June 5, 1911. Metallic yoke engages enlargement on socket base to clamp same to a base.

1,075,613. SOCKET AND TERMINAL CONNECTION FOR ELECTRIC LAMPS; W. C. Tregoning, Cleveland, Ohio. App. filed June 5, 1911. Special T-shaped terminal.

1,075,614. IMAGE-TRANSMITTING TELEGRAPH; L. Tschörner, Vienna, Austria-Hungary. App filed June 27, 1910. Making and breaking of the circuit alternately actuates the reproducing means and means which produce relative movement between the receiving surface and reproducing means.

1,075,615. VAPOR-ELECTRIC DEVICE; E. Weintraub, Lynn, Mass. App. filed April 3, 1911. Has means to prevent the arc being struck in the space between the inner and outer envelopes.

1,075,634. PROCESS FOR THE PRODUCTION OF REFRACTORY ELECTRICALLY CONDUCTING MOLDED BODIES; G. Egly, Berlin, Germany. App. filed June 25, 1912. Heats mixture of carbon and silicon in atmosphere of carbon nonoxide to obtain SiCO and heats same in the presence of carbon to reduce the SiCO to SiC.

1,075,660. ELECTROLYTIC CELL; C. W. Marsh, Greenwich, Conn. App. filed April 18, 1913. Has plurality of superposed electrolyte chambers provided with opposite lateral openings for receiving the electrodes.

1,075,683. ELECTRIC-MOTOR DRIVE; C. C. Batchelder, Schenectady, N. Y. App. filed June 23, 1909. Parts of paper-making or like machine are driven at the different requisite speeds by separate motors with frequency changers connected between the several motors and alternating-current buses.

1,075,717. WHEEL STRUCTURE; R. MacRae, Chicago, Ill. App. filed Feb. 26, 1912. Driving motor is carried within the wheel.

1,075,713. ELECTRODE; J. L. R. Hayden, Schenectady, N. Y. App. filed May 12, 1912. Contains cerium titano-fluoride and sodium titano-fluoride.

1,075,733. PRESSURE-OPERATING DEVICE; A. Simon, Milwaukee, Wis. App. filed Nov. 4, 1909. Upon occurrence of abnormal conditions, the pressure device automatically operates the rheostat to insert sufficient resistance to protect the motor.

1,075,749. CIRCUIT-BREAKER; C. C. Badeau, Bethlehem, Pa. App. filed Aug. 11, 1908. Protecting switch in which one of the switch terminals, the magnet coil and a switch member are formed of a flexible strip of metal.

1,075,768. ARC-LAMP ELECTRODES; F. R. Crane, Jr., Chicago, Ill. App. filed March 31, 1913. Composed of comminuted carbon, soda ash, cast-iron filings, metallic magnesium and a clay binder.

1,075,775. WAX MELTING AND SEALING DEVICE; M. Fournier and G. H. Jackson, La Rochelle, France. App. filed Nov. 1, 1912. Special arrangement of heat-conducting bodies.

1,075,786. APPARATUS FOR PRODUCING AND UTILIZING MICRO MOVEMENTS IN WEAK CURRENT TECHNICS; J. A. Johnsen, Copenhagen, Denmark. App. filed April 11, 1911. Freely movable coil suspended from a resilient bar secured in axis of the poles of an electromagnet with a strong current.

1,075,799. CONTROLLING CAM; C. M. Walker, Pueblo, Col. App. filed Feb. 26, 1912. For centering the pivotal arm of the switch without the use of springs.

1,075,873. APPARATUS FOR BLEACHING AND FOR PREPARING BLEACHING, DEODORIZING AND DISINFECTING SOLUTIONS; O. Summer, St. Margaret's-on-Thames, England. App. filed April 22, 1913. Tapered chamber within tank; electrode in the tank and one in the tapered chamber.

1,075,882. INDICATOR AND POWER DEVICE THEREFOR; W. E. and M. E. Walters, Los Angeles, Cal. App. filed Aug. 7, 1912. Hidden electromagnet rotates a visible indicator.

1,075,897. ELECTRODE; R. N. Chamberlain and S. J. Hall, Chicago and Hinsdale, Ill. App. filed Dec. 6, 1912. Of hollow construction.

1,075,953. ELECTRIC-LAMP SWITCH; J. A. M. Traus, Rotterdam, Netherlands. App. filed Jan. 24, 1911. Liquid contact maker operated by a cam.

1,075,955. DOOR-LOCK SWITCH; G. Wright, Schenectady, and H. P. Ball, New York, N. Y. App. filed Feb. 19, 1908. Lights turned out when door is locked from the outside.

1,075,978. DENTAL WATER FILTER AND HEATER; C. Joerin, Jr., and A. E. Joerin, Detroit, Mich. App. filed May 8, 1913. Heating of water under control of user.

1,075,986. ELECTRIC SWITCH; J. F. McElroy, Albany, N. Y. App. filed Sept. 16, 1909. For controlling an electric heater in the cabs of electric railway cars.

1,075,987. AUTOMATIC CONTACTING DEVICE; F. McMahon, Union City, Ind. App. filed May 22, 1911. For charging storage batteries when dynamo has reached predetermined speed; for use on autos, etc.